SPOKANE RIVER BRIDGE AT SPOKANE, WASHINGTON

BY

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ARMOUR INSTITUTE OF TECHNOLOGY

1911

Construction of the Spokane River Bridge

of the

Idaho & Western Railway

at

Spokane Bridge, Wash.

A THESIS

presented by

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to the

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of

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for the degree of

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SPOKANE
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Dishman
C.M. & P.S. Loc.
Chester
W.W.P.Co
S P O K A N E
Rockford
Spangle
Fairfield
Waverly
Latah
N G T O N
PARALLEL
NORTH
Moldenhawer
Rosalia
Pinecroft
Pine City
Oakesdale
Thornton
Lamont
K O O T E N
COEUR D'ALENE
Harrison
Plummer
INDIAN
RESERVATION
Swopes
I D

CONSTRUCTION OF THE SPOKANE RIVER BRIDGE, IDAHO & WESTERN RY.

Object:- To describe the method of construction of the Spokane River Bridge at Spokane Bridge, Wash., on the Idaho & Western Ry.

General Description:- The Idaho & Western Railway Co. recently completed a line from Dishman, Wash. to Coeur d'Alene, Idaho, a distance of 25.3 miles. At Dishman a connection with the Oregon-Washington Railroad & Navigation Co. gives access to Spokane on the west, and to the main line of the Chicago, Milwaukee & Puget Sound Ry. on the south, via Plummer, Idaho.

The Idaho & Western Ry. is a subsidary company of the Chicago, Milwaukee & Puget Sound Ry., being more familiarly known as the Coeur d'Alene Branch. To the north of the line is the Spokane Valley, well known as productive of fruits and garden truck. To the south are the foot hills of the Coeur d'Alene mountains, having a good growth of pine and fir.

The small scale map on page 5 shows the new line colored red, the main line of the Chicago, Milwaukee & Puget Sound Ry. being shown dotted.

Immediately after passing the Washington-Idaho

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General Description:- The Idaho & Western Railway Co. recently completed a line from Diamond, Wash. to Coeur d'Alene, Idaho, a distance of 25.3 miles. At Diamond a connection with the Oregon-Washington Railroad & Navigation Co. gives access to Spokane on the west, and to the main line of the Chicago, Milwaukee & Puget Sound Ry. on the south, via Plummer, Idaho.

The Idaho & Western Ry. is a subsidiary company of the Chicago, Milwaukee & Puget Sound Ry., being more familiarly known as the Coeur d'Alene Branch. To the north of the line is the Spokane Valley, well known as productive of fruits and garden truck. To the south are the foot hills of the Coeur d'Alene mountains, having a good growth of pine and fir.

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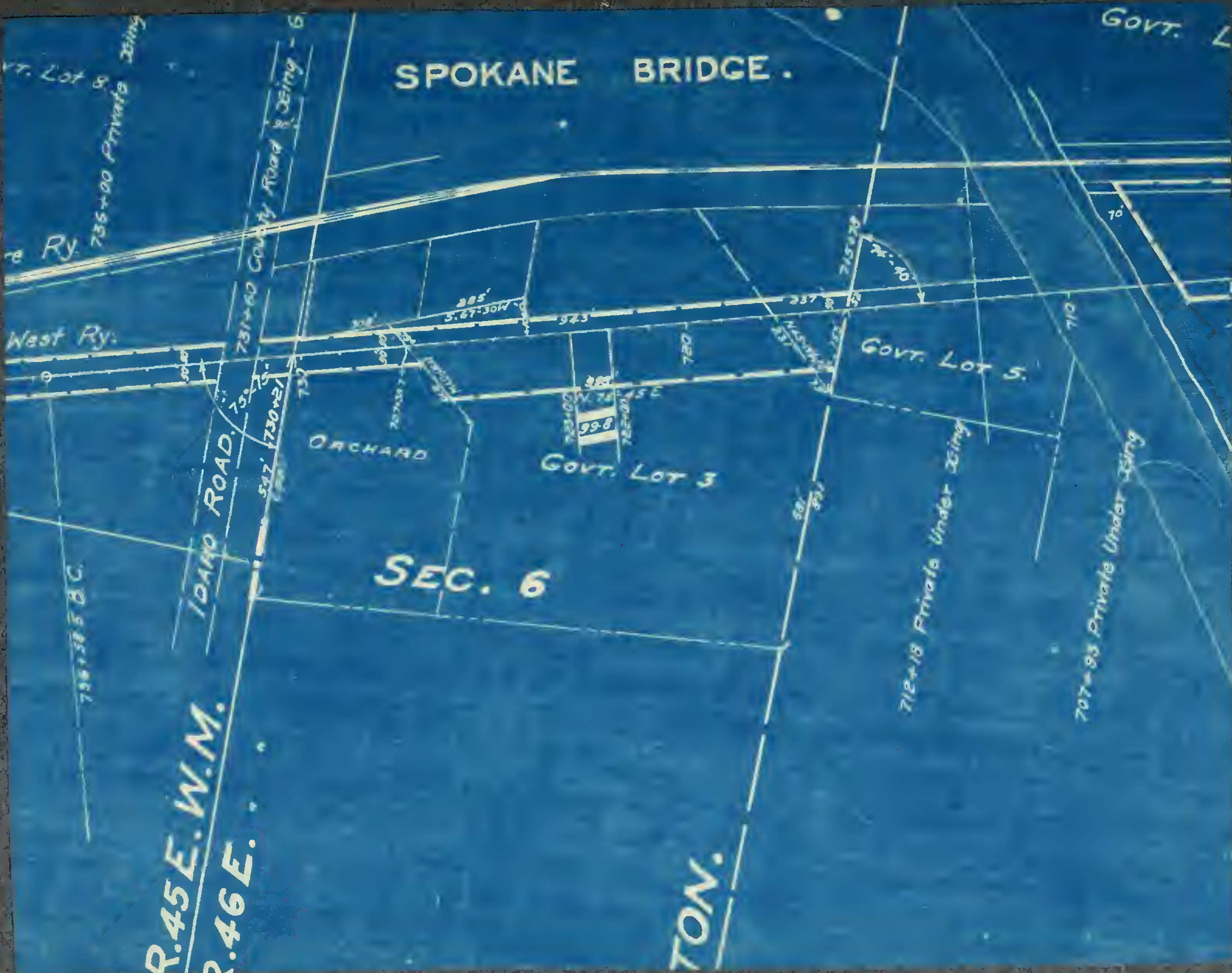
SPOKANE BRIDGE.
Govt. Lot 5.
Govt. Lot 3
Orchard
Sec. 6
Idaho Road.
West Ry.
735+00 Private Xing
731+60 County Road Xing
712+18 Private Under Xing
707+93 Private Under Xing
736+38.5 B.C.
R.45E. W.M.
R.46E.
TON.

State line the railway crosses the Spokane River, 18.5 miles from Spokane and 12.1 miles from Dishman. The entire structure, including the west approach, is in Idaho.

The Idaho & Western bridge crosses the river 400 feet up stream from the new crossing of the Inland Empire System. The old crossing of the Inland Empire System being about 300 feet down stream from the new, and is being considered as a crossing structure for the new state road. The town of Spokane Bridge, Wash. being within a quarter of a mile of all their structures is most appropriately named.

The Spokane River bridge consists of two reinforced concrete arch approaches and three concrete piers. Four 80 foot steel girders form the spans. The piers are constructed to accommodate a future second track to be constructed south of the present line. (See map on page 11) The approaches were constructed for single track, with the footings only for the future second track structure.

The concrete approaches are reinforced above the footings and are decked with reinforced concrete slabs, built on the ground and placed after setting.

At present the deck on the steel girders is of timber, but this will be replaced by reinforced concrete slabs in the near future.

Under each of the approaches is a private roadway constructed by the railway company for adjacent property owners. These roads are gravel filled and have grades not exceeding 8 per cent.

The concrete construction and roadway work was done by the Bates & Rogers Construction Company of Chicago and Spokane. The following articles of the contract show its general nature:

(1) The contractors agree to furnish all the labor, superintendence, and to handle the work of construction, the employment of necessary labor and the purchase of material ordered by the engineer, is to be in accordance with the Chief Engineer's instructions or authority, which also covers the rates for labor and the terms and prices for purchases. The work is to be done in accordance with the plans, specifications, instructions and requirements of the Chief Engineer of the railway.

(2) Furnish all equipment, plant and tools required for the performance of the work.

(3) Provide and furnish the camp and to board the employes.

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quirements of the Chief Engineer of the railway.

(2) Furnish all equipment, plant and tools requis-
ite for the performance of the work.

(3) Provide and furnish the camp and to board the
employes.

(4) Commence the work forthwith and to handle it at such a rate of progress as will secure completion prior to greater difficulty incident to the fall floods and unfavorable weather.

The Railway Company agrees to

(1) Pay the contractors their pay roll for labor and for supervision employed on the work in the actual performance of the same.

(2) Pay the purchase cost of all material entering into the construction of the work.

(3) Pay the contractors the agreed per cent on items (1) and (2) as compensation for their tools, equipment, their services and their profits. (Freight charges are not included in the amounts on which percentage is paid.)

The steel work was built by the railway company and erected by company forces.

Camp:- The camp site for this work was located on the west side of the Spokane river, being within a short distance of Spokane Bridge, a station on the Inland Empire System, where all supplies and materials were shipped to. The topography of the country is very flat and a gradual down grade from the town to the work, over a good gravel road, made easy teaming.

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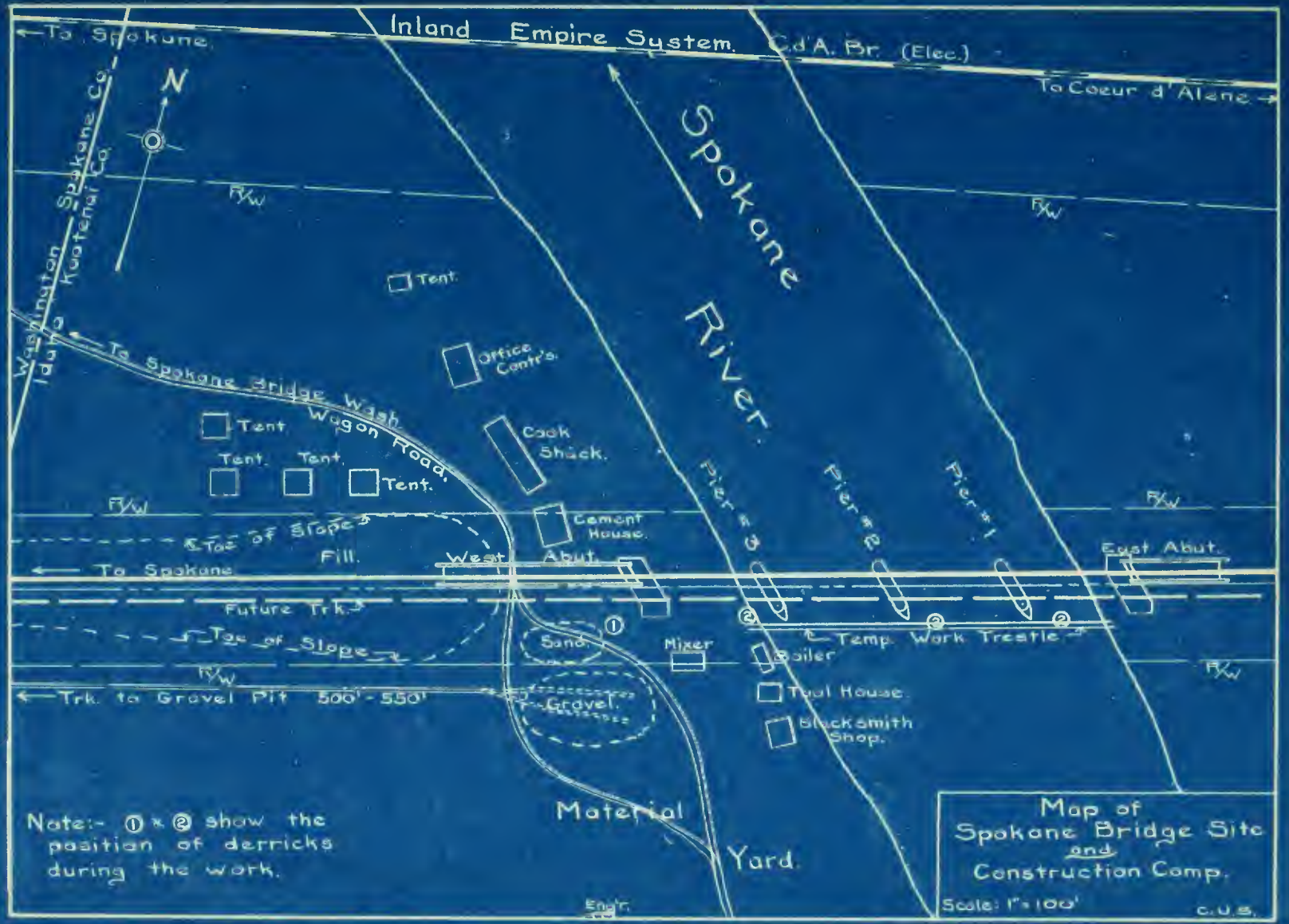
Inland Empire System. C.d'A. Br. (Elec.)
To Spokane
To Coeur d'Alene
N
Washington Spokane Co.
Idaho Kootenai Co.
Spokane River.
R/W
Tent.
Office Cont's.
To Spokane Bridge Wash.
Wagon Road.
Tent.
Tent.
Tent.
Tent.
Cook Shack.
Cement House.
Toe of Slope
Fill.
West Abut.
East Abut.
To Spokane
Future Trk.
Toe of Slope
Sand.
Mixer
Boiler
Temp. Work Trestle
Tool House.
Blacksmith Shop.
Trk. to Gravel Pit 500'-550'
Gravel.
Pier #3
Pier #2
Pier #1
Material Yard.
Eng'r.
Note:- ① & ② show the position of derricks during the work.
Map of Spokane Bridge Site and Construction Camp.
Scale: 1" = 100'
C.U.S.

Reference to the map on page 11 shows the location of the camp to good advantage. All the work was done on the south, or up stream side of the line. On this side the blacksmith shop, tool house, boiler, mixer and material yards were located. To the north of the line were the cement storage house, contractors office and commissary, cook shack and sleeping tents.

The camp being almost entirely off of the railway company's right of way, a small rental was paid to the owner for the use of the site. Although the land could have been used free, the payment of a small sum released the occupants from any damage claims which might have arisen during the course of construction.

As the contract states, the camp was run entirely by the contractors and they made all the profit derived from it. A price of 25 cents per meal was charged and deducted from the men's time. A commissary furnished the men with tobacco, gloves, clothing, etc., credit being given against the time checks.

The buildings for the camp were put up at the expense of the contractors, excepting those actually used in the performance of the work. Upon the completion of the work all buildings were removed and the site left as it originally was. The contractors sold the material in their camp build-

Reference to the map or plan will show the location of the camp to good advantage. All the work was done on the right, or on either side of the line. On this side the planing mill, tool house, boiler, mixer and material yards were located. To the north of the line were the general storage house, contractors office and commissary, camp shack and sleeping tents.

The camp being almost entirely off of the railway company's right of way, a small rental was paid to the owner for the use of the site. Although the land could have been used free, the payment of a small sum released the occupants from any damage claims which might have arisen during the course of construction.

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ings for a lump sum, while that for the railway company's buildings was returned to the second hand stock.

Plant & Equipment:- The contractors plant for this work had an estimated value of approximately $15,000 and consisted of the following equipment:

One 1/2 yard Smith concrete mixer, boiler and engine attached.

Five bottom dump Stuebner cone buckets.

Two 6 1/4 x 10 American hoisting engines complete.

One 50 ft. mast guy derrick complete.

One 30 ft. mast stiff leg derrick complete.

One 40 H.P. Nagle portable boiler with fittings.

One 5" Emerson pump.

One Gould centrifugal pump with engine attached. (Used engine only.)

One 6 x 4 x 6 Fairbanks Morse force pump.

One 6 x 4 x 6 Laidlow & Dunn force pump.

One 5 1/2 x 7 Comstock upright engine.

One skid pile driver complete, 30 ft. leads.

One 2800 lb. pile hammer.

One 800 lb. pile cap.

Three concrete cars (One lost in river) complete.

Two push cars, complete with trucks.

One gravel car, complete with trucks.

One travel car, complete with trucks.
Two push cars, complete with trucks.
One concrete cars (One float in river) complete.
One 10" pile cap.
One 12" pile hammer.
One 3 x 4 x 6 Derrick Crane for pile driver.
One 3 x 4 x 6 Derrick Crane for pump.
One 1 1/2 x 7 Concrete upright mixer.
One 8"x8" pile driver complete, 70 ft. leads.
One 12" x 12" Duplex pistable boiler with fittings.
One 5" Emerson Pump.
One Gould centrifugal pump with engine attached.
(Used engine only.)
One 4 x 4 x 6 Fairbanks Morse Horse Power.
One 3 x 4 x 6 Laidlow - Dunn Gor - Pump.
One 1 1/2 x 7 Concrete upright mixer.
One 8"x8" pile driver complete, 70 ft. leads.
One 12" x 12" pile hammer.
One 10" pile cap.
Three concrete cars (One float in river) complete.
Two push cars, complete with trucks.
One travel car, complete with trucks.

One 40" circular saw.

One 36" circular saw.

One 2 1/2" shaft for saw.

Four #2 slip scrapers.

Sixteen steel tray wheel barrows, 2 ft. capacity.

Six cross cut saws.

Eighteen #2 shovels, D handle, round point.

Ten #2 shovels, D handle, square point.

Four long handle round point shovels.

Three spades.

700 ft. 1" dia. manilla rope.

600 ft. 1 1/4" dia. manilla rope.

300 ft. 5/8" dia. manilla rope.

4610 ft. 1/2" wire hoisting rope.

1840 ft. 5/8" wire guy rope.

60 picks with handles.

Six pike poles.

Three 8 lb. mauls.

Eight 10 lb. mauls.

One set blacksmith tools.

One forge complete with blower.

One grind stone, 2" face.

One Barren track jack.

One 150 lb. anvil.

One 150 lb. anvil.

One pipe jack.

One grind stone, 2" face.

One forge complete with blower.

One set blacksmith tools.

Eight 10 lb. sacks.

Three 8 lb. sacks.

Six pick poles.

One 1000 ft. 3/8" wire guy rope.

1000 ft. 1/2" wire hoisting rope.

300 ft. 5/8" manila rope.

600 ft. 1 1/4" dia. manila rope.

700 ft. 1" dia. manila rope.

Three spades.

Four long handle round point shovels.

Ten D2 shovels, handle, square point.

Fifteen D2 shovels. handle, round point.

Six cross cut saws.

Sixteen steel tray wheel barrows, 4 ft. capacity.

Four D2 slip scrapers.

One 2 1/2" shaft for saw.

One 36" circular saw.

One 40" circular saw.

Five cant hooks.

Four carry hooks.

Seven axes.

Four pair of rubber boots, hip.

Five double blocks, wood.

Four double blocks, iron .

One snatch block, iron.

Six ship augers.

Three timber dollies.

Two Marshalltown trowels.

Two vises.

Five monkey wrenches.

Three pipe wrenches.

One pipe cutter.

One set Armstrong stock and dies.

One set Little Giant stock and dies.

One 10" x 12" split pulley.

One 2" and one 3" flue roller.

One small sand screen.

Six lanterns.

Crow bars, claw bars, pinch bars, chains, etc.

Other equipment on the work, but not actually used in construction consisted of:

One Clam shell bucket.

One line shaft bucket.

construction consisted of:

Other equipment on the work, but not actually used in

Crow bars, claw bars, pinch bars, chains, etc.

Six lanterns.

One small sand screen.

One 2" and one 3" line roller.

One 10" x 12" split pulley.

One set Little Giant stock and dies.

One set Armstrong stock and dies.

One pipe cutter.

Three pipe wrenches.

Five monkey wrenches.

Two vises.

Two Barnhalltown trowels.

Three timber collies.

Six ship augers.

One auger block, iron.

Four double blocks, iron .

Five double blocks, wood.

Four pair of rubber boots, big.

Seven axes.

Four carry hooks.

Five cant hooks.

One orange peel bucket.

One 50' mast guy derrick complete.

The camp equipment consisted of four 16 x 18 tents, 12 oz., stoves, etc. with a cooking outfit for 150 men.

The engineers outfit consisted of one 14 x 16 tent, one 7 x 7 tent, drafting table, chairs, desk and the customary engineering instruments. All the tents were framed, floored and half walled covered with tarred paper.

Material:- Gravel:- The gravel for this work was a good coarse grade, that would mesh 90% through a 3/4" sieve, lying under a lava strata, was taken out of a pit on the railway company's right of way and washed there, it was then dumped into a car and carried down to the work on a gravity track and unloaded at the storage pile as indicated on the map page

The gravel was picked up in the pit with slips. It was then dumped through a trap and washed with a hose, as it went down a 30 degree incline to the storage hopper. The car was run under this hopper and filled. The outlet of the hopper being arranged with a trap door operated by a lever.

When a car was filled it was started down grade to the storage pile, where it was dumped and returned to the loading hopper with a horse.

The force on this work averaged two slip teams with drivers, one horse with driver to pull back empty car, two men on car, two men on slips, one washerman and three men on the dump. About 100 yards a day were handled with one car, 2700 yards were hauled, the average haul being 500 to 550 feet.

Sand:- The sand was obtained from a local pit about one mile south of the work. It was loaded at the pit in 1 1/2 yard wagons and dumped on the work at the storage pile.

The sand was bought at a unit price per yard, engineer's measurement, and hauled at a contract price per yard. The average delivery per day was nine yard per team, three teams working only when the roads were in good condition.

Nine hundred and fifty-five and one half yards of this sand, which was sharp and of a fine grade, were delivered.

Cement:- The cement used was the Santa Cruz blue cross brand. It was shipped from Seattle via Plummer, Idaho and Spokane over the Chicago, Milwaukee & Puget Sound RY., Oregon-Washington Railroad and Navigation Co. and Inland Empire System to Spokane Bridge, Wash. It was unloaded there by the contractors and hauled to the store house, a distance of about 350 yards.

The force on this work averaged two city teams with drivers, one horse with driver to pull back empty cars, two men on cars, two men on slips, one watchman and three men on the dump. About 1200 yards a day were handled with one car, 2400 yards were handled, the average haul being 600 to 650 feet.

Sand:- The sand was obtained from a local pit about one mile south of the work. It was loaded at the pit in 1 1/2 yard wagons and dumped on the work at the storage pile.

The sand was bought at a unit price per yard, engineer's measurement, and hauled at a contract price per yard. The average delivery per day was nine yard per team, three teams working only when the roads were in good condition.

The hundred and fifty-five and one half yards of fine sand, which was sharp sand of a fine grade, were delivered.

Cement:- The cement used was the Santa Cruz Nine cement brand. It was shipped from Seattle via Tacoma, Idaho and Spokane over the Chicago, Milwaukee & Puget Sound R.R., Oregon-Washington Railroad and Navigation Co. and Inland Empire System to Spokane Bridge, Wash. It was unloaded there by the contractors and hauled to the store house, a distance of about 350 yards.

The average labor to unload and store was about four teams and two men with driver for each team. There were 30 sacks to a load and approximately 900 sacks in a car. 14 cars were received.

12067 sacks were delivered, 11902 sacks were used in the work, 157 sacks were sent away on rush work, 8 sacks remained to be returned to stock. The cement was shipped in sacks of four to a barrel.

The cement was sampled in the cars before shipment, only two cars being sampled at the work. The following are the figures of a test of one sample.

Tensile Strength

Lbs. per square inch

1 day	7 days	28 days
485	790	825

Time of Setting

Initial Minutes	Final Hours
110	4 1/2

Fineness

Per cent of residue on

#100 sieve	#200 sieve
1.8	13.2

100 sieve	#200 sieve
1.8	13.2

Fineness

Per cent of residue on

Time of Setting

Initial Hunter	Final Hours
110	4 1/2

Tensile Strength

lbs. per square inch

1 day	7 days	28 days
450	790	825

The cement was sampled in the cars before unloaded, only two cars being sampled at the work. The following are the figures of a test of one sample.

The average labor to unload and store was about four tons and two men with driver for each team. There were 30 sacks to a load and approximately 900 sacks in a car. 14 cars were received.

12067 sacks were delivered, 11902 sacks were used in the work, 157 sacks were sent away on truck, 8 sacks remained to be returned to stock. The cement was shipped in sacks of four to a barrel.


3


4

Per cent of water used 21

Specific gravity 3.10

A sand test proportioned 1 to 3 by weight showed:

Tensile strength

in lbs. per square inch

7 days	28 days
387	420

9.5 per cent of water used.

Reinforcing Bars:- The reinforcement was square corrugated bars 1/2" - 3/4" and 1" sizes, varying in shipping lengths from 6' to 40'.

These were shipped from the main line via Plummer and Spokane to Spokane Bridge and from there hauled by team to the yards.

In the yards the bars were sorted and cut to the various plan lengths. They were then taken to the blacksmith shop and bent into the required shape as they were needed in the work.

The following list shows the amount of reinforcing material used in the work:

East Abutment

Size	1/2"	3/4"	1"	Total
Lin.ft.	6167	6544	3285	15996
Lbs.	5242	12519	11169	28930

per cent of water used 5.5

Specific gravity 3.10

A sand test proportioned 1 to 3 by weight showed:

Tensile strength

in lbs. per square inch

7 days	28 days
387	420

5.5 per cent of water used.

Reinforcing Bars:- The reinforcement was square corrugated bars 1/2" - 3/4" and 1" sizes, varying in outgoing lengths from 6' to 40'.

These were shipped from the main line via Tunnel and Spokane to Spokane Bridge and from there hauled by team to the yards.

In the yards the bars were sorted and cut to the various plan lengths. They were then taken to the blacksmith shop and bent into the required shape as they were needed in the work.

The following list shows the amount of reinforcing material used in the work:

Steel Abutment

Size	1/2"	3/4"	1"	Total
Lin.ft.	21127	17284	2585	12996
lbs.	8542	12312	11169	32023

West Abutment

Size	1/2"	3/4"	1"	Total
Lin.ft.	14391	9817	10998	35206
Lbs.	12232	18780	37393	68405

Timber, Lumber and Piling:- The timbers used in the work trestle and upon various structures as mixer platform, gravel washer, etc., were old bridge timbers shipped to Spokane Bridge from the main line yards and hauled to the work by team.

The contractors used 45956 feet B.M. of this material, not including the timber in the temporary trestle. Of this 34660 feet B.M. was recovered upon the completion of the work and sent into the old material supply again. The remainder was either lost in the river, or cut into such lengths as were not acceptable for further use.

The form lumber and caisson timber was shipped via the Inland Empire System to Spokane Bridge from a local mill in Coeur d'Alene. That which was left at the end of the work was sent into the railway company's old material stock.

Approximately 135000 feet B.M. of small dimensioned stock was used for forms, cofferdam, sheds, etc. The amount used in the caissons for Piers #1 and #2 was about

Timber, Lumber and Piling:- The timbers used in the
vool treatle and upon various structures as water give-
fore, gravel washer, etc., were old bridge timbers
to Spokane Bridge from the main line yards and Tacoma
the work by them.

The contractors used 43956 feet B.M. of this mat
ted including the timber in the temporary treatle.
this 24610 feet B. M. was recovered upon the completion of
the work and sent into the old material supply yards.
remainder was either lost in the river, or cut into
short lengths as were not acceptable for further use.

The form lumber and ceiling timber was shipped
Inland Empire System to Spokane Bridge from a yard
Mill in Coeur d'Alene. That which was left at the end
of the work was sent into the railway company's ma
terial stock.

Approximately 175000 feet B. M. of small timber
etc. was used for forms, staging, chute, etc. The
several used in the instance of the Latah Creek


Spokane River Bridge
Oct 9, 1910
5

61900 F.B.M. From these two items approximately 17900 F.B.M. were returned to old material stock. The form lumber was 2 x 8 stock, with 3 x 12 planks for flooring, runways, etc., and 3 x 8 M. and D. material for sheeting.

The piling also came from Coeur d'Alene and was unloaded on the old main line of the Inland Empire System opposite the work. From there it was brought to the work by team as needed.

The switching charges by the Inland Empire System for the use of the main line were a minimum of $5.00 for one hour. Unloading there was a great saving as two cars came in at once and could be unloaded in an hour, saving a long team haul and providing a storage yard on the Inland Empire System right of way.

10000 lin.ft. of piling was used. The piles were fir and tamarack of 20 - 25 - and 32 foot lengths. At the completion of the work the pile cut offs were sent into the old material stock to be used for building foundations and fuel.

Miscellaneous:- Such items as nails, oil, waste, small tools, etc., ordered from time to time on the work, were shipped from dealers in Spokane via the Inland Empire System to Spokane Bridge by local freight or express.

The following list shows the amount of nails, oil, bolts, etc. used during the course of construction:

Article	Amount
Coal from Bellview, B.C.	160 tons
Drift bolts	2100
10 d nails	20 kegs
60 d nails	8 "
40 d "	6 "
16 d "	17 "
20 d "	2 "
8 d "	1 "
3/8" x 8" boat spikes	6 "
3/8" x 3" track spikes	50 lbs.
Nuts and washers	65 "
Tool steel and iron	1450 "
Packing	33 "
Mill brooms	1 doz.
8" files	18
Tarred felt	8 rolls
Waste	1 bale
Blacksmith coal	6 sacks
Oakum	50 lbs.
White lead	25 "
Boiler compound	10 gals.
#16 Annealed wire	12 rolls
9 " "	17 "
Coal oil	1 drum
Lubricating and cylinder oil	50 gals.
Cup grease	20 lbs.

The above list does not include iron washers and bolts ordered on engineer's requisition, or that shown on plan bills of material.

All material was ordered by the contractors at the direction of the engineer in charge and bills rendered at the end of the month. The only exception to this

being the cement, reinforcing bars and old timber which were ordered on requisition of the Division Engineer.

Labor:- The labor on this work was furnished by the contractors as stated in the contract. A specimen of the daily force report on page 27 shows the average force on the work.

These reports were sent to the office of the Division Engineer and to the main office of the contractors upon the completion of each day's work. By this method a daily report of the progress of the work was always on record and in determining the cost of the various parts of the work was absolutely necessary.

Distributions for all the work done were kept in this way being classified for each separate pier or abutment and also for general work as gravel, cement handling, bridge protection, rip rap, etc.

The superintendence of the work for the contractors was done by a general superintendent who made occasional trips to the work, but was not resident there. During his absence a general foreman had entire charge, but was always subject to the orders of the engineer on the work.

The wages paid for the various classes of labor is shown in the specimen report. These were constant throughout, with the exception of the wages for common

Bates & Rogers Construction Co.

355 Dearborn Street, Chicago.

DAILY REPORT.

P. O. ADDRESS Box 17

BRIDGE Spokane DATE, Oct. 31 1910

WORK DONE:		COST LABOR.	
East Abutment or Pier EXCAVATION	CU. YDS.	4	50
Pier #2 " CONCRETING	CU. YDS.	21	97
West " FORMS		43	86
Pier #2 "		14	05
Pier #1 PILES DRIVEN NO. 7 LIN. FT. 224		23	23
Hauling Lumber		7	50
Reinforcing W. Abut.		7	30
Gravel		35	34
		$157	75

FORCE:					
1	FOREMEN	@ $ 125 00	PER Mo.	4	03
3	ENGINEERS	" $ 3 50	PER DAY.	10	50
12	CARPENTERS	" $ "	"	42	00
1	" 4man	" $ 4 00	"	4	00
4	LABORERS	" $ 2 50	"	10	00
26	"	" $ 2 25	"	58	50
1	Blacksmith	" $ 3 50	"	3	50
1	TIMEKEEPERS	" $ 75 00	" Mo.	2	42
2.8	TEAMS & Men	" $ 6 00	" day	16	80
1	Rigger	" $ 3 00	"	3	00
1	Engineer	" $ 3 00	"	3	00
		" $	"		
				$157	75

NO. SACKS CEMENT USED

EXPECT TO COMPLETE THIS JOB 191

REMARKS: 18 yds. of sand delivered
90 yds. of gravel hauled
Average penetration Pier #1 piling 17.1 ft

WEATHER: Clear

C. H. Smith
FOREMAN.

laborers, which were cut from 25 cents per hour to 22 1/2 cents and finally to 20. Exceptionally good men of this class were paid in a like proportion 27 1/2 - 25 and 22 1/2 cents per hour.

The largest force on the work at one time consisted of the following:

1 General Foreman
1 Carpenter "
1 Pile driver "
4 Engineers
10 Carpenters
4 Carpenter helpers
1 Blacksmith
2 Riggers, or pile driver men
1 Timekeeper
3 Teams
1 Single horse and man
51 Laborers

For a time during the driving of piling for foundations a pile driver foreman was on the pay roll for 40 cents per hour. This was only a temporary expense, as the general foreman and carpenter foreman were ample to direct the work other than pile driving where supervision

must be constant.

Construction-Concrete Sub-structure:- The construction work will be discussed in the actual order of its progress and not for each abutment and pier separately. This is done because the work did not proceed in the direct order of Piers #1, #2 and #3, but often two or more pieces of work were in progress at one time.

Before the permanent bridge work was commenced, it was deemed necessary to construct a temporary timber trestle to be used for traffic in the event of the non-completion of the permanent bridge at the time track was to be laid. This temporary structure was built and complete before the bridge contractors were ready to work.

In order to have an advantageous means of carrying on the work, it was deemed advisable to build a temporary work trestle to transport concrete on and also for the use of the pile driver. This was therefore started at once. Twenty-one 3 pile bents were driven and decked with old bridge timbers. The piling used were 20 x 25 ft.lengths.

While the temporary trestle was under construction, the timbers for the cofferdam for Pier #3 were being framed and put in place. This cofferdam was 14' x 45' inside of the sheeting. The method of construction was:


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Four 12 x 12 timbers were fastened together in the form of a rectangle and floated into the desired position, being held in place by lines and bracing to temporary work. The sheeting, 3 x 8 M. & D. material, was then put in place around this waling, being held at intervals by small nails. When the entire waling was walled up with sheeting a similar waling was built on the outside, about two feet distant all around on three sides, the west side being in such shallow water that outside protection was not necessary, the puddling material being placed up against the sheeting with no backing.

When this second frame was made it was walled up on the inside with 3 x 12 rough lumber. The puddling material, local surface dirt, was them dumped in between these two walls. The puddling process being completed the inside was pumped out and the leaks tamped tight.

The excavation was next started. This was done by hand, the material being loaded into bottom dump buckets, which were handled by a stiff leg derrick situated at (2) near Pier #3 (map page 11) the material being deposited around the cofferdam.

The waling and sheeting were driven down by hand operated tamps. When down about six feet a second waling was built of the same dimension as the first

The excavation was next started. This was done by hand, the material being loaded into bottom dump buckets, which were handled by a stiff leg derrick attached to a bear (See page 12) the material being deposited on the cofferdam.

The wailing and sheeting were driven down by hand operated tamps. Then down about six feet a second wailing was built of the same dimension as the first with sheeting a similar wailing was built on the outside, about two feet distant all around on three sides, the west side being in such shallow water that outside protection was not necessary, the puddling material being placed up against the sheeting with no backing.

Then this second frame was made it was filled on the inside with 3 x 12 rough lumber. The puddling material, local surface dirt, was then dumped in between these two walls. The puddling process being completed the inside was pumped out and the leaks stopped tight.


B


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and put in place about five feet above it. This method of driving sheeting and excavating was then continued until the desired level was obtained in the cofferdam.

A 5" Emerson pump was used in this cofferdam and proved of ample capacity, although the leakage was considerable at times. This was the only wet excavation on the work.

During the cofferdan work the boiler was put in place as shown on map, the gravel washer built and track laid from it to the storage yard, the mixer platform was built and the mixer set up, the tool house and blacksmith shop were built and excavation started on the west abutment.

By the time the excavation in the cofferdam was completed the work trestle was also finished and the pile driver was returned to Pier #3 site ready for driving the foundation piling in the cofferdam. This foundation consisted of 88 - 20 and 25 ft. piles driven every 2' 3" along the center line of the pier and every 2' 6" at right angles to it.

The piles were driven until they practically stopped, or to an average penetration of 10.2 ft. The cofferdam was allowed to fill during the pile driving and was pumped out after all the piles were driven. They were

proved of ample capacity, although the leaking con-
crete at times. This was the only set back on
the work.

The pile driver was returned to Tier 25 site ready for driv-
ing the foundation piling in the cofferdam. This op-
eration consisted of 20 - 30 and 20 ft. piles driven on
7' 3" along the center line of the pier and every
at right angles to it.

The piles were driven until they practically
or to an average penetration of 10.0 ft.
was allowed to fill during the pile driving

then cut off, by hand, about 1.5 ft. above the ground. A small box was made to carry the water around the sides of the cofferdam to the pump in one corner and everything was in readiness for concrete.

During the process of pile driving at Pier #3 forms were being cut for the nose and back, material delivered and the river bed at Pier #2 site raked with an iron hook to remove large surface boulders.

The pile driver was moved to Pier #2 and 93 - 32 ft. piles were driven every 2' 6" along the center line and every 3 ft. at right angles to it. These were also driven to an approximate stand still, to a penetration of 18.9 ft. During this pile driving Pier #3 was concreted. The concrete being placed with bottom dump buckets which were handled by the derrick at (2).

In the meantime the excavation for the west abutment was continued and construction started on the caisson work for Pier #2. This caisson consisted of three tiers of 12 x 12 S. 1. S. timber bolted together, making a solid base 14 x 48 x 3 ft. On this the side and end walls made of 3 x 12 M. & D. material were fastened by long hook bolts running from the top sill to the base. They were fastened together at the ends by bolts so that when they were used at Pier #2

Grinding [illegible] for [illegible] Bridge
Driving [illegible] for Piers
Spokane [illegible] Bridge Oct. 25, 1910 L 83 10

the bolts were removed and the sides and ends came off and were floated into place and set up again on the base for Pier #1.

While waiting for the forms to be placed for the neatwork of Pier #3 the excavation for the main part of the West Abutment was finished and the footing concreted. The concrete was deposited by cars running on a track from the mixer to the foundation.

The pile driving at Pier #2 being finished the driver was moved to Pier #1 site, which had been previously raked for boulders, and 94 - 32 ft. piles were driven here. These piles were spaced the same as for Pier #2 and were driven until the movement under last blow of hammer with fall of 20 ft. was less than an inch. The average penetration was 17.8 ft.

While the pile driver was working at Pier #1 the forms for the neatwork of the West Abutment were being made, Pier #3 was stripped, the rip rap work around Pier #3 was started after the cofferdam sheeting had been pulled, the guy derrick at (1) was set up and the engine moved from (2) near Pier #3 to operate it and the piling at Pier #2 were cut off.


Pier 3 completed
Grillage for Pier 4 floating
Spokane River Bridge Oct 22 1910 J.S.
11

The piling were cut off under water with a circular saw on a vertical shaft. This shaft was mounted on a frame that held the engine and was operated by a belt. Skidways were fastened to the temporary trestle and guide piling and rails were placed on them to an exact level. The saw was set to cut over the highest point of rock on the bottom and held in place by a collar on the shaft. A steam line was laid from the boiler to the saw engine and connection made with steam hose.

The cutting was started at the up stream end of the pier and the frame was skidded back and forth at right angles to the center line of the pier being fed ahead as each row of piling was cut. The levels of the cut offs were frequently checked and the saw re-set if necessary. After all the piles were cut a variation in level of only .03 ft. was found.

When the piles were cut and the skidways and saw frame removed, the work trestle was opened and the completed caisson was floated into place. It was lined in and when in position was secured by bracing to the temporary structure and the guide piles.

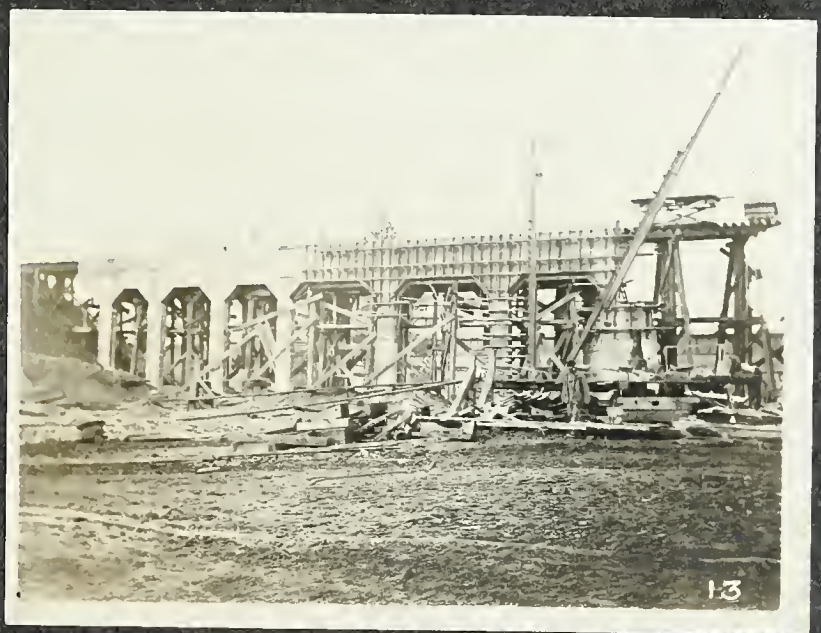
During this work the pile driving at Pier #1 was completed and the saw was moved to cut the piling there in the method previously described. The pile driver was then taken apart and the engine of the pile driver used on the stiff leg derrick, which was set up at (2)

The cutting was started at the up stream end of the pier and the frame was pushed back and forth at right angles to the center line of the pier until a cut was made. After all the piles were cut a ventilation in level of deck, 20 ft. was found.

Then the piles were cut and the stringers and frame removed, the work trestle was opened and the completed entrance was floated into place. It was fitted in and when in position was secured by bracing to the temporary structure and the guide piles.

During this work the pile driving at the [illegible] was completed previously mentioned. The pile [illegible]


12


13

The rip rap work at Pier #3 was completed also, the concreting of the main West Abutment and some rip rap was placed in front of the main east abutment site. The footing pedestals for the west abutment were excavated and all concreted with the exception of those for the future track.

The concrete was next placed in the caisson at Pier #2. It was carried from the mixer in buckets on cars and then hoisted by the derrick into the caisson where it was distributed evenly to prevent undue settling at any one place during the process of sinking. The caisson being calked and water tight there was no trouble in working the concrete.

When the caisson was sunk onto the piling, being reset for alignment just before it was completely down, the footing was allowed to set up before the forms for the neatwork were put in place. As much of the form work as could be saved from Pier #3 was used as the shafts of all three piers were of the same dimension making the forms interchangable.

During the concreting of Pier #2 the forms for the columns of the west abutment were placed, the reinforcing bars were cut and bent, the caisson base for Pier #1 was made, and the excavation for the main east


Hill. Br. over

abutment started. The gravel was also delivered during this time and the washer and track taken up.

The excavation for the east abutment was attended with some difficulties. The material was coarse gravel and sloughed off considerably, breaking back so far in the main abutment site as to endanger the temporary trestle, which had to be jacked up and repaired with a cribbing under it. The excavation for the footing pedestals were very deep to prevent slipping on the side hill and for this work dry cofferdams had to be built to hold back the dirt on the sides of the excavations. Interference with the temporary trestle also caused more cribbing to be done to maintain that structure.

The west abutment approach was next concreted. The mixture for this work was made very wet and was thoroughly worked by spades against the face, every effort being made to get a good surface and not expose the rods which were within two inches of the forms. The work of spading in the columns was exceedingly difficult as the rods in place left very little room for a man to work and it was necessary for him to move out whenever a car of concrete was dumped.

The concrete for the west abutment was emptied into buckets at the mixer, which were raised by the derrick at

The excavation for the east abutment was attended with some difficulties. The material was coarse gravel and sloughed off considerably, breaking back so far in the main abutment site as to endanger the temporary trestle, which had to be backed up and repaired with a cribbing under it. The excavation for the footing pedestals were very deep to prevent slipping on the side hill and for this work dry coffer-dams had to be built to hold back the dirt on the sides of the excavation. Interference with the temporary trestle also caused more cribbing to be done to maintain that structure.

The west abutment approach was next concreted. The mixture for this work was made very wet and was tamped by wedges against the face, every effort being made to get a good surface and not expose the rods which were within two inches of the forms. The work of wedging in the columns was exceedingly difficult as the rods in place left very little room for a man to work and it was necessary for him to move out whenever a car of concrete was dumped.

The concrete for the west abutment was supplied from the mixer, which were raised by the derrick at

(1) and dumped on a platform on the temporary trestle. From here it was shoveled into a side dump car and conveyed to the place where it was to be used. For concreting the columns it was shoveled into chutes that ran down into the structure. For the side walls and cross beams it was dumped on a platform and shoveled directly into the work. Great care at all times was observed in the placing of this concrete not to disturb the reinforcement.

When the concreting was completed at Pier #2 the derrick and engine were removed to (2) Pier #1 to be used on concreting this Pier. It was then decided to place the caisson for Pier #1, but before this was done the gates of a large dam at Post Falls, Idaho were opened and the water rose four feet bringing all manner of drift with it.

So great was the accumulation of drift that both the work and temporary trestles were in danger. This called for the entire labor force to keep an open channel and send the accumulated drift down the river. This condition prevailed for 12 days, but at the end of this time, although no further inconvenience was caused by drift, the water did not go down more than one half foot, making it inadvisable to place the Pier #1 caisson as it

the placing of this concrete not to disturb the reinforcement.

Then the concreting was completed at Pier [illegible] derrick and engine were removed to (3) Pier [illegible] used on concreting this Pier. It was then decided to place the caisson for Pier 4, but before this was done the gates of a large dam at Coat Falls, Idaho were opened and the water rose four feet bringing [illegible] of dirt with it.

So great was the accumulation of drift that [illegible] the work and temporary trestles were in danger. [illegible] called for the entire labor force to keep an open channel and used the accumulated drift down the river. This condition prevailed for 12 days, but at the end of [illegible] time, although no further inconvenience was suffered by [illegible] the water did not go down more than one foot, making it impossible to place the Pier 4 caisson on its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might have broken its moorings or got ten something under it, due to the current, that would have prevented it from sinking to a level footing.

The labor force was increased at this time and the concfete wprk on the west abutment was completed. The footings for the main east abutment were also concreted. The concrete for this work was carried across the work trestle in push dump cars and emptied directly onto the work. The engine at Pier #1 was rigged to help the cars up an incline at the east end of the work trestle.

While the concreting of the east abutment was under way, track was laid across the temporary structure and as daily work trains were in operation it was necessary to arrange for a rapid means of clearing the track on the bridge. Therefore the platform used on the west abutment work was arranged to that it was not fastened to the structure, but could be lifted off with the derrick, to which a long boom was attached to handle the concrete for the east abutment.

All the concrete with the exception of the main abutment footings on the east abutment, both plain and reinforced, was placed by push cars on the temporary trestle, the concrete being deposited in chutes which were


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shortened as necessary. The side walls and cross beams were concreted from a platform similar to that used on the west side.

Shortly after track was laid the water fell considerably and it was deemed advisable to place the caisson for Pier #1. To protect the caisson from any small amount of drift that might be a menace to the work, a boom was placed in front of the Pier site after the caisson was placed.

The concreting of Pier #1 was handled in a manner similar to that used at Pier #2. This work was rapidly done, as the bridge crew were waiting to place the steel and some time was necessary for the concrete to set before it was advisable to put any weight on it. The erection of the steel will be discussed later.

During the concreting of the east abutment and the time forms were being built for Pier #1, the rip rap work was going on at Pier #2. This rip rap consisted of surface boulders picked up on the land surrounding the work, by permission of the owner, loaded on teams and hauled to the west end of the work trestle, here it was loaded on a push car and taken to its destination. This work was done whenever the laborers were not needed on concreting and during the general clearing up.

the west side.

Shortly after track was laid the water fell considerably and it was deemed advisable to place the caisson for Pier 1. To protect the caisson from heavy wall account of drift that might be a menace to it, a boom was placed in front of the pier site after the caisson was placed.

The concreting of Pier 1 was handled in a manner similar to that used at Pier 2. This work was rapidly done, as the bridge crew were waiting to place the steel and some time was necessary for the concrete to set before it was advisable to put any weight on it. The erection of the steel will be discussed later.

During the concreting of the east abutment of Pier 1 forms were being built for Pier 3, the pile for which was going on at Pier 2. This trip was consumed [illegible] piloted up on the land [illegible] permission of the owner, located on [illegible] the east end of the work in mid, here it was [illegible] tion to the destination. The [illegible] over the Lawrence were not needed or [illegible] and for the general clearing up.


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At about this time the future track footings for both the east and west abutments were placed, as it was desired to use the site for storage of the deck slabs.

The deck slabs were concreted in forms placed on specially constructed platforms to the south of the west abutment and between it and the sand pile. These were allowed to set for at least ten days and were then moved by the derrick (1) and piled up close to the west abutment for the derrick car to pick up readily when placing. All the slabs were made with two bars placed in them in the form of a U, making a place for hooks to be attached in handling.

When all the concrete had been placed, the work of making the roads at the east and west abutments was begun. This was done with slip teams and hand shoveling, the material being dumped off of flat cars by a Lidgerwood plow. These cars were in use in the track surfacing and the gravel was loaded into them by a steam shovel in a cut about one half mile from the bridge.

While the roadways were being made the rip rap work was finished and the yard cleaned up. All the material to be returned to stock was piled up to the south of the west abutment within reach of the guy derrick (1). The contractors equipment was hauled up on the right of way

both the east and west abutments were placed, as it was desired to use the site for storage of the dock as be.

The dock slabs were concreted in forms placed x specially constructed platforms to the south of the west abutment and between it and the sand pile. These were allowed to set for at least ten days and were then moved by the derrick if and piled up close to the west abutment for the derrick car to pick up readily when placing. All the slabs were made with two bars placed in them in the form of a U, making a place for boxing to be attached in handling.

When all the concrete had been placed, the work of making the roads at the east and west abutments was begun. This was done with city teams and wheel scrapers, the material being dumped off of flat cars by a switch erected place. These cars were in use for the trestle work and the gravel was loaded into them by a shovel in a cut about one half mile from the bridge.

While the roadways were being made the trestle was finished and the guard planks put on. All the material to be returned to storage was piled up to the south abutment within reach of the derrick.

The contractors equipment was handled by an electric


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opposite the town of Spokane Bridge to be stored until needed again.

The temporary work trestle was pulled out by the engine at (1), it being moved for this work over where the boiler had been. A block was fastened to a tree on the east bank and the cable with a chain on it stretched across. One drum of the engine was used to pull the chain out and the other to return it. Beginning at the west end by this means all the work trestle was pulled ashore and the salvaged material was piled up with the other old stock.

Upon the completion of all the clearing up and storing of material a work train was furnished and loaded by means of guy derrick. All the material thus loaded was shipped to Dishman and turned into the second hand stock. The ground was leveled off with slip teams and the site was left in good order with no unsightly rubbish lying around to mar the appearance of a very sightly structure.

A reference to the cost sheet in the appendix gives all the information in regard to the yardage, mixtures, and various distributions.

The work was commenced on August 29, 1910 and completed on Feb. 6, 1911. Stormy weather interfered with

The work was commenced on August 29, 1910 and completed on Feb. 6, 1911. Stormy weather interfered with

the work on 5 days, a very small percentage. Concrete was actually placed on 56 days. One accident due to the carelessness of a gang foreman in dropping a heavy block on his foot was the only one of consequence during the entire work.

The present temporary trestle made it impossible to run the center line of the track so the line was off set and run in front of the piers. The piers were at an angle of 60 degrees with the center line and were lined in from points set on the old Inland Empire System bridge. Vibration and rough usage made it impossible to use the temporary trestle for permanent sights.

No forms were used in the bottom footings in any of the work. The footings of the piers were placed against the caissons and for all the abutment pedestals they were put in place in the excavation without form work.

Upon the completion of the work full details of yardage, mixture, materials and all matters of importance during the construction and bearing on future work were recorded on blue ptints and sent to the office of the Chief Engineer.

The plans were made in Chicago, under the direction of C. F. Loweth and the construction was handled under Division Engineer A. G. Holt, in Spokane. The writer

The plans were made in Chicago, under the direction of C. K. Lowth and the construction was handled under Division Engineer A. G. Holt, in Spokane. The writer


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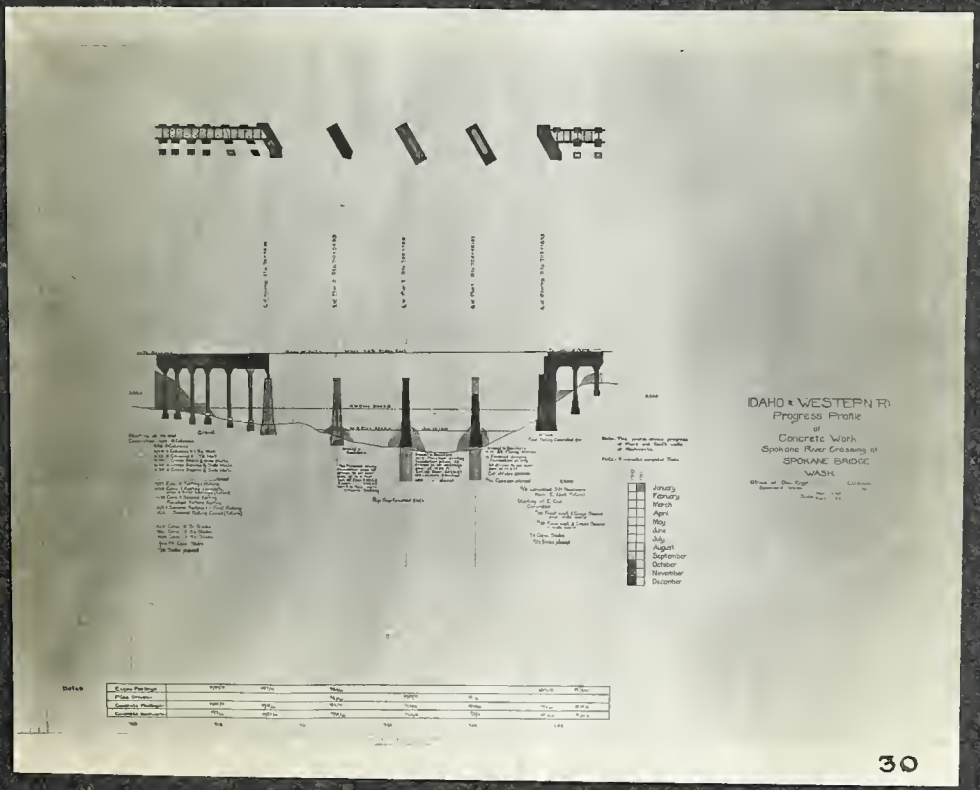
IDAHO & WESTERN R'D
Progress Profile
of
Concrete Work
Spokane River Crossing at
SPOKANE BRIDGE
WASH.
January
February
March
April
May
June
July
August
September
October
November
December

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was the engineer in charge of the work in the field.

For diplomatic reasons it is not deemed necessary to go into the details of the cost of the work, although the cost sheet is shown in the appendix.

Steel:- The steel work consists of four 80 foot girders, 3 of them 9' 6 1/2" deep, made by the railway company for this bridge and one 8' 5 1/2" deep made originally for a main line bridge, but used on this work to economize.

The shallow girder was originally a right angle girder and was delivered as such. The necessary work to change it to a 60 degree skew, being done in the yard at the bridge. This girder was placed at the east end. The method of erecting the steel will be briefly described. The equipment consisted of two 30 ton derrick cars, with 50 ft. boom, one compressor car, tool cars and the necessary boarding cars for a crew of 30 men, only 12 of these being steel workers.

Girders were brought out on a temporary trestle, on two flat cars with a derrick car on each end. They were then lowered to rest on the second track portion of the piers and a temporary bent at the abutments.

The bents of the temporary trestle were then pulled out down to the caps on the piles. The bed plates were

engineer in charge of the work in that
for diplomatic reasons it is not deemed necessary
to go into the details of the cost of the work, al-
though the cost sheet is shown in the appendix.

Steel:- The steel work consists of four 60 foot
girders, 2 of them 9' 6 1/2" deep, made by the rail-
company for this bridge and one 8' 5 1/2" deep made
originally for a main line bridge, but used on this
work to economize.

The shallow girder was originally a right angle
girder and was delivered as such. The necessary work
to change it to a 60 degree skew, being done in the yard
at the bridge. This girder was placed at the east end.

The method of erecting the steel will be briefly
described. The equipment consisted of two 50 ton
Derrick cars, with 50 ft. booms, one compressor car,
tool cars and the necessary boarding cars for a crew
of 30 men, only 12 of these being steel workers.

Girders were brought out on a temporary trestle,
on two flat cars with a derrick car on each end. They
were then lowered to rest on the second track portion
of the piers and a temporary bent at the abutments.

The length of the temporary trestle were then pulled
up even to the caps on the piles. The one flat car


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set on sheet lead over the places marked out on the concrete to receive them. The girders were then picked up with derrick at each end and swung into place. A temporary timber deck was then put on the concrete slabs for the steel not being made. This operation was repeated at each opening.

The piling of the temporary trestle was then pulled or broken by the derricks and the work was completed.

When all the steel was placed the riveting was done and the holes bored in the concrete for the anchor bolts. These bolts were slit and driven in on wedges, a neat cement being poured around them as a filler.

The slabs on the approaches were set in a like manner. The trestle was pulled out and the slabs which had been previously piled within reach of the derrick cars were picked up and put in place on a 1" bed of mortor. The deck was then replaced and the cracks between slabs filled with mortor. The ballast on the slab deck will be of crushed rock, being drained through holes provided in the slabs. This gives a solid, noiseless floor with little maintenance cost as compared to the old type of bridge decks.

The end.

Appendix-Cost Data:- The cost of all the work was carefully recorded and separate distribution made of it for material and labor. This was tabulated upon the completion of the work and is shown on the blue print of the cost sheet. A full set of the working plans for the sub-structure are included, as printed from the tracing on file in the office of the Bridge & Building Department of the railway company.

Respectfully submitted,

Clarence Ubling Smith

117 - W 16th Ave.

Spokane

Wash.

Idaho and Western Ry.
Coeur d' Alene Branch
A.G. Holt Div Engr.
Spokane.
Wash.

Cost Sheet of Concrete Work on Spokane River Bridge at Spokane Bridge Wash.

Bates and Rogers Constr. Co
Contractors.
Work Commenced August, 29, 1910
Work Completed February, 6, 1911
Compiled by C.U. Smith, Insp.
Spokane, Wash. Feb 20, 1911.

Remarks.	Distribution:—	East Abut'mt.	Pier Number 1.	Pier Number 2.	Pier Number 3.	West Abut'mnt	General.	Totals.	Totals.
Labor.	Excavation.	$372.65			$281.60	$236.66		$890.91	
	Piling.		$699.30	$730.86	311.67			1741.93	
	Caissons. (Grillage.)		288.02	341.38				628.40	
	Cofferdam.				169.89			169.89	
	Puddling.				71.59			71.59	
	Forms.	614.83	261.49	293.02	252.09	1139.93		2621.36	
	Reinforcing.	389.60				1011.92		1411.52	
	Concrete.	1048.38	555.02	570.60	363.22	1509.03		4046.25	
	Backfilling.	66.82				33.04		99.86	
	Gravel.	326.01	220.73	223.88	228.74	473.15		1479.18	
	Hauling Lumber.	44.98	74.08	75.00	55.06	83.50	$10.82	343.44	
	Hauling Cement.	62.67	41.47	46.66	41.40	85.60		287.82	
	Rip Rap.	140.10	603.43	869.02	339.34	16.31		1968.80	
	Roadway.	173.61				162.75		336.36	
	Outfit.						607.92	607.92	
	Fencing.						9.73	9.73	
	Loading Piling.						27.93	27.93	
	Temporary Work Trestle.						279.03	279.03	
	Repairing Falsework.						352.71	352.71	
	Clearing River (Log Jam.)						445.20	445.20	
	Clearing Up.						515.66	515.66	
	General Roll. (Supr'tdnce, etc.)						90.45	90.45	
	Liability Insurance.						534.05	534.05	
Percentage.	Totals.	3249.65	2743.54	3150.21	2116.20	4827.88	2873.50	18960.99	
	Percentage. (12½%)	406.20	342.94	393.78	264.52	603.49	359.19	2370.12	
	Totals.	$3655.85	$3086.48	$3543.99	$2380.72	$5431.38	$3232.69		$21331.11
Material.	Sand.	$195.30	$132.51	$133.92	$138.57	$288.30		$888.60	
	Cement.	1425.05	946.00	1064.80	940.50	2169.75		6546.10	
	Piling.		261.36	266.64	161.45		$143.55	833.00	
	Reinforcing Bars. 1 inch	187.64				628.21		815.85	
	" " ¾ "	208.88				313.36		522.24	
	" " ½ "	102.11				238.31		340.42	
	Lumber.	17.42				34.84	265.71	317.97	
	Forms.	311.76	112.58	115.06	121.24	576.51		1237.15	
	Cofferdam.				284.20			284.20	
	Caissons (Grillage)		425.83	425.83				851.66	
	Miscellaneous.	69.64	144.11	141.07	39.30	114.63	605.12	1113.87	
	" (Office, etc.)						114.50	114.50	
	Totals.	2517.80	2022.39	2147.32	1685.26	4363.91	1128.88	13865.56	
	Percentage. (12½%)	314.73	252.87	268.42	210.57	545.49	141.11	1733.19	
	Totals.	$2832.53	$2275.26	$2415.74	$1895.83	$4909.40	$1269.99		$15598.75
Not Percentage.	Freight.	163.39	132.50	146.00	106.87	249.51	1172.21	1970.48	
	Miscellaneous.						71.92	71.92	
	Engineering (Salaries, etc.)						1233.36	1233.36	
	Totals	$163.39	$132.50	$146.00	$106.87	$249.51	$2477.49		$3275.76
	Grand Totals.	$6651.77	$5494.24	$6105.73	$4383.42	$10590.29	$6980.17		$40205.62

General Data:—

Labor Unit Cost:—

Excavation.

Location.	Yards.	Cost per Yard.
East Abutment	455	$ .82
Pier No 2	93 (100 Cu.yds)	$1.09
West Abutment	242	$ .98
Total	790	$1.13

Piling.

Location.	Lin. Ft. Driven	Cost per Lin Ft.
Pier No 1	3168	$ .22
Pier No 2	3232	$ .224
Pier No 3	1697	$ .16
Wire Trestle	1749	$ .11
Total	10097	$ .19

Concrete.

Location.	Footings.	Network.	Plain.	Network.	Net.
East Abutment	212 Yds.	693 Yds.	175 Yds.	96.5	1182 Yds. 81.5
Pier No 1	78 "	174.5 "			13 "
Pier No 2	73 "	146.5 "			12 "
Pier No 3	110 "	147.5 "			16 "
West Abutment	300 "	148.5 "	176.5 "		2.5 "
Total	774 "	1268 "	365 "		

Gravel.

Location.	Yards.	Cost per Yard.
Total	2627	$ .563

Rip Rap.

Location.	Yards.	Cost per Yard.
East Abutment	210	$ .67
Pier No 1	560	$1.04
Pier No 2	750	$1.16
Pier No 3	240	$1.42
West Abutment	20	$ .81
Total	1800	$1.09

Material Unit Cost:—

Sand.

3559 Yds. At 1st & Pine Hauling 8 Cts. Total $ 4.32 $ 4886.60

Cement.

Cost $2.20 per Bbl. Freight charges $.20 per Bbl. to Spokane

Loc.	Footings.	Network Plain.	Network Reinf.
E Abut	2225 Bbls.	150 Bbls.	275 Bbls.
Pier No 1	748 "	385 "	
Pier No 2	825 "	401 "	
Pier No 3	1285 "	302 "	
W Abut	245 "	1295 "	551 "
Totals.	750 "	1384 "	826 "

Reinforcing Bars.

	East Abutment	West Abutment	Total
1" @ 1.04 per 100*	11152 lbs.	31332 lbs.	42484*
¾" @ 1.00 " "	12484 "	18622 "	31086*
½" @ 1.78 " "	4669 "	10930 "	15610*
⅝" @ 3.56 " "	559 "	1303 "	1862*
Totals	28845 "	62276 "	91121*

Future Work Cost.

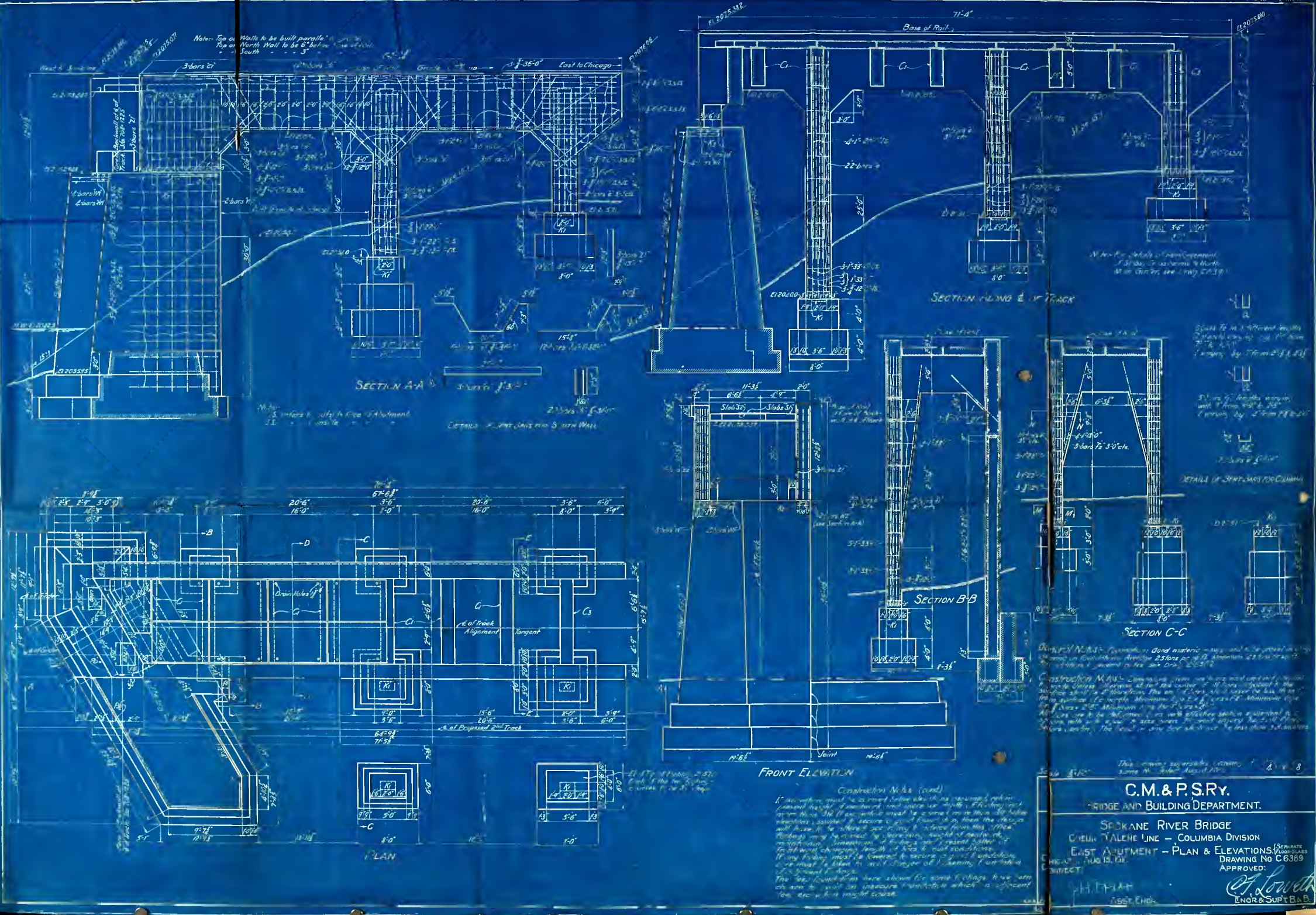
East Abutment	West Abutment
$107.00	$166.00

Mixtures.

	E. Abut.	Pier No 1.	Pier No 2.	Pier No 3.	W. Abut.
Footings	1-2½-5	1-2½-5	1-2½-5	1-2½-5	1-2½-5
Net (Plain)	———	1-2½-5	1-2½-5	1-2 -5	———
" (Reinf.)	1-2½-5	1-2 -5	1-2 -5	1-2 -5	1-2 -5
" (Cyclo)	———	1-2 -4	1-2 -4	1-2 -4	———
" (Paint)	1-2 -4	———	———	———	1-2 -4

Cost per Yard of Concrete = $ 15.30
Concreting Commenced: Oct 3, 1910
Concreting Completed: Jan 31, 1911
Days Concreting: 96

All concrete mixed with 1 Smith Mixer, excepting one future footing W Abut. Gravel from pit on ½ South of Sta 71. Sand from Humbergs Pit about one mile South of Bridge.



Construction Notes (cont'd)

If concrete must be placed below elevation required, permission must be obtained from the Engineer before placing concrete. Top 3'0" of pedestals must be formed to the size shown on plans, and if concrete is placed in excess, it must be removed before placing bearings. Elevations, dimensions of bearings and location of anchorages, dimensions of anchors are governed solely by the requirements of the bearings furnished by the contractor. If any bearing must be lowered to secure a true bearing, the pedestal must be lowered to the bottom of bearing. Concrete in pedestals must be placed in one continuous operation.

The "as built" plans show the actual dimensions and elevations of the structure.

C.M.&P.S.Ry.

BRIDGE AND BUILDING DEPARTMENT.

SPOKANE RIVER BRIDGE

COEUR D'ALENE LINE — COLUMBIA DIVISION

EAST ABUTMENT — PLAN & ELEVATIONS (SEPARATE FOR SLABS)

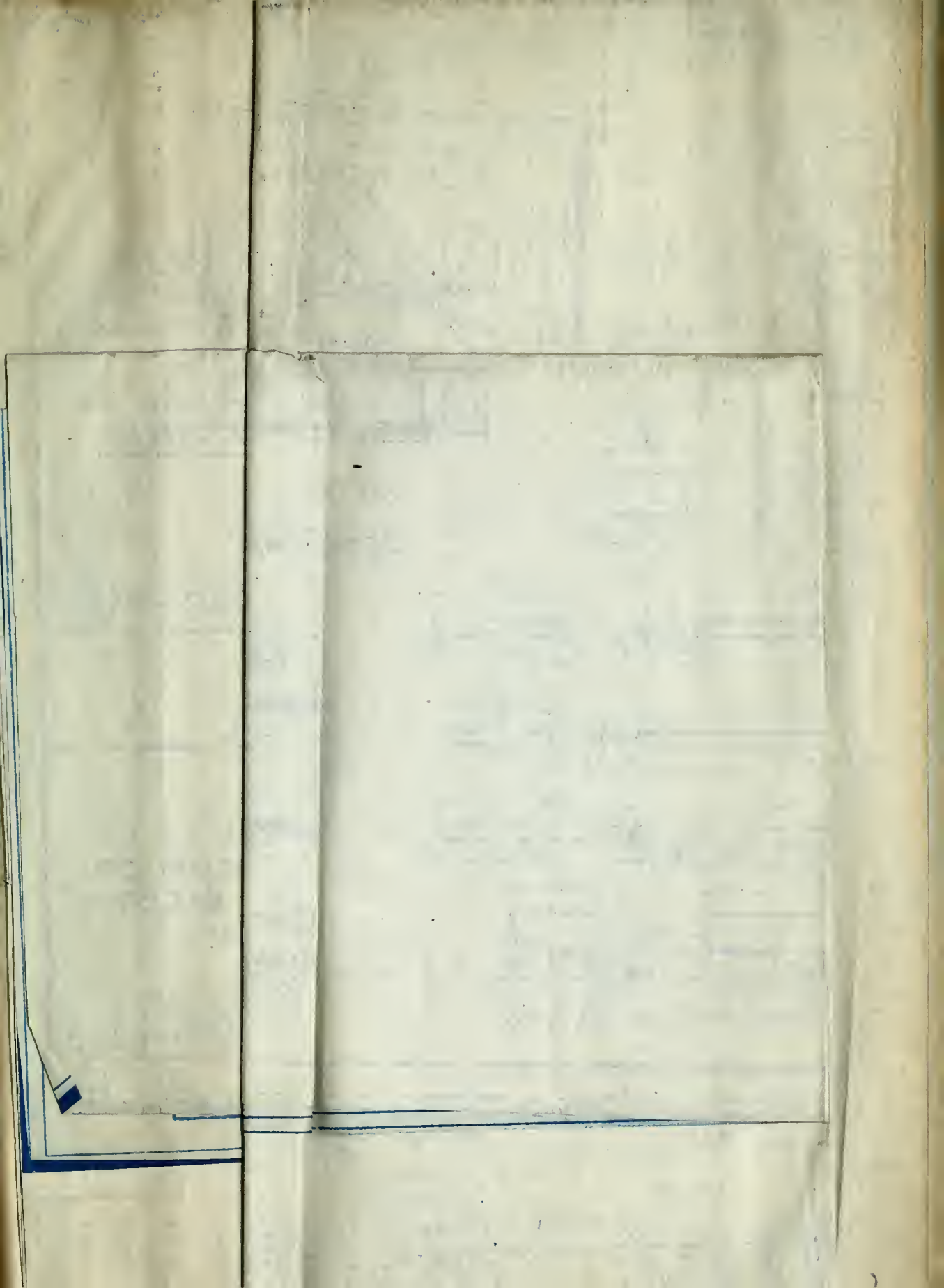
DRAWING NO C 6389

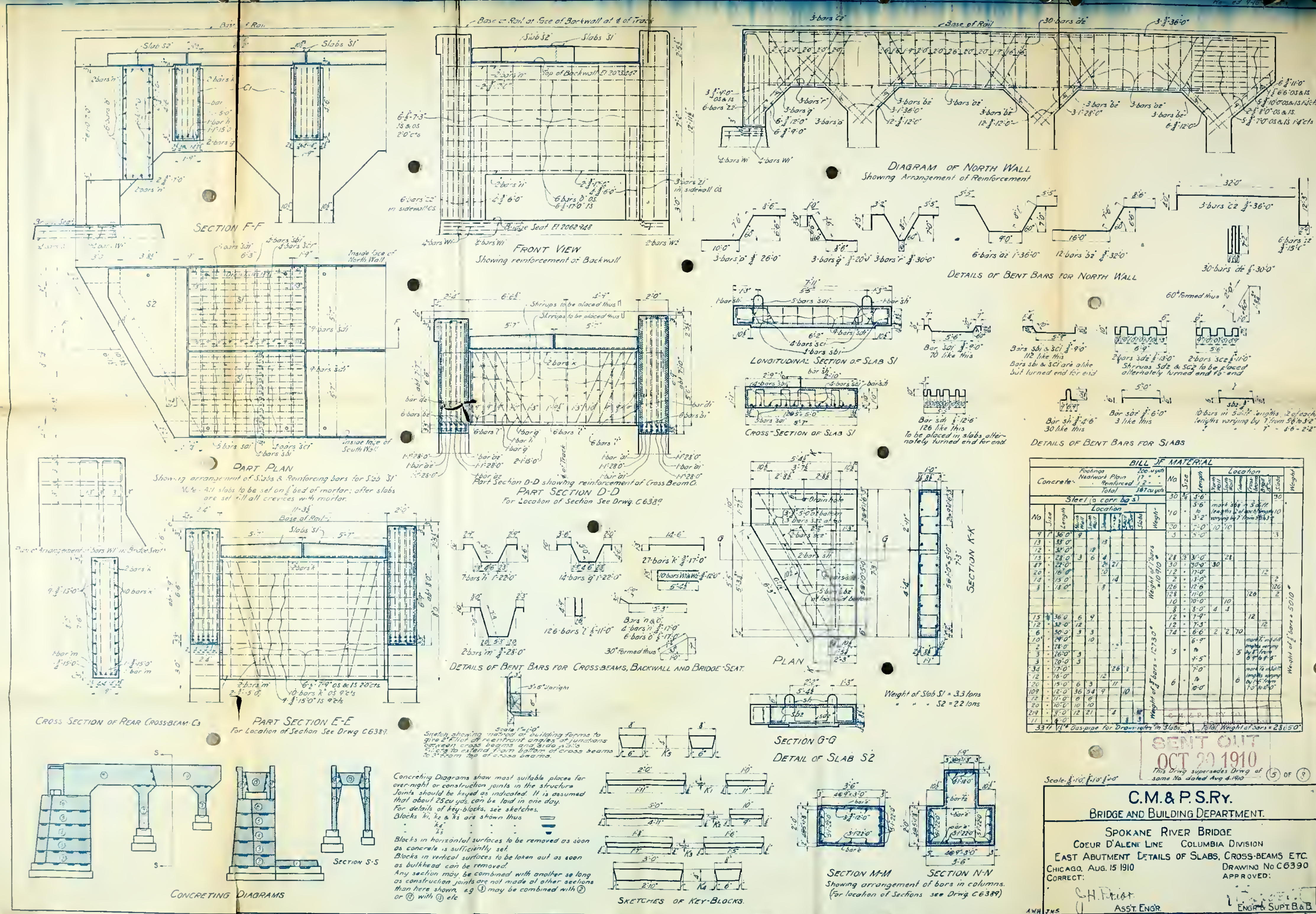
APPROVED:

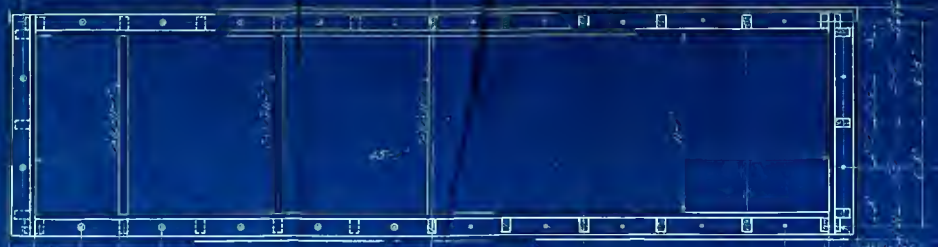
ENGR & SUPT B & B.

DIRECT:

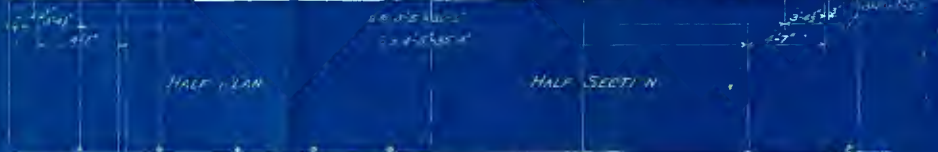
ASST. ENGR.



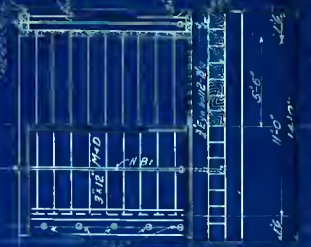

Section F-F
Front View
Showing reinforcement of Backwall
Diagram of North Wall
Showing Arrangement of Reinforcement
Details of Bent Bars for North Wall
Part Plan
Showing arrangement of Slabs & Reinforcing bars for Slab 'S1'
Note: All slabs to be set on 1/2" bed of mortar; after slabs are set fill all crevices with mortar.
Part Section D-D showing reinforcement of Cross Beam C.
Part Section D-D
For Location of Section See Drwg C6389
Longitudinal Section of Slab S1
Cross-Section of Slab S1
Details of Bent Bars for Slabs
Bill of Material
Weight of Slab S1 = 3.3 tons
Weight of Slab S2 = 2.2 tons
Section K-K
Plan
Section G-G
Detail of Slab S2
Details of Bent Bars for Cross-beams, Backwall and Bridge-Seat.
Cross Section of Rear Crossbeam C3
Part Section E-E
For Location of Section See Drwg C6389.
Scale 1"=1'-0"
Sketch showing method of building forms to give 2" Fillet at reentrant angles at junctions between cross beams and side walls. Fillets to extend from bottom of cross beams to 3" from top of cross beams.
Concreting Diagrams show most suitable places for over-night or construction joints in the structure. Joints should be keyed as indicated. It is assumed that about 25 cu yds. can be laid in one day.
For details of key-blocks, see sketches.
Blocks 'k1, k2 & k3' are shown thus
" 'k4' " " "
" 'k5' " " "
Blocks in horizontal surfaces to be removed as soon as concrete is sufficiently set.
Blocks in vertical surfaces to be taken out as soon as bulkhead can be removed.
Any section may be combined with another so long as construction joints are not made at other sections than here shown, e.g. ③ may be combined with ② or ⑫ with ⑬ etc
Section S-S
Concreting Diagrams
Sketches of Key-Blocks
Section M-M
Section N-N
Showing arrangement of bars in columns.
(For location of Sections see Drwg C6389)
SENT OUT
OCT 20 1910
This Drwg supersedes Drwg of same No. dated Aug 4. 1910
⑤ of ⑨
Scale 1/8"=1'0", 1/4"=1'0", 1/2"=1'0"
C.M. & P. S. Ry.
Bridge and Building Department.
Spokane River Bridge
Coeur D'Alene Line
Columbia Division
East Abutment Details of Slabs, Cross-beams etc.
Chicago, Aug. 15 1910
Drawing No C6390
Correct:
Approved:
C.H. Prior
Ass't. Eng'r.
Eng'r & Supt. B & B.
AWH
JMS



HALF PLAN



HALF SECTION

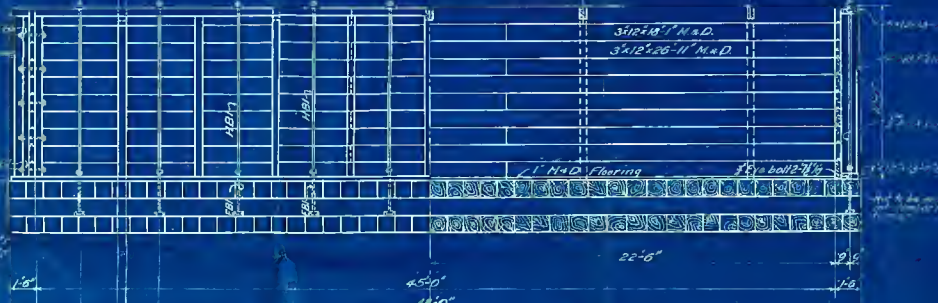


HALF ELEVATION & HALF SECTION

BILL OF MATERIAL FOR 2 CAISSONS (PIERS Nos. 1 & 2)

No.	DESCRIPTION	REMARKS
56	Posts 6"x10"x9'-6"	Rough
6	" 3"x10"x9'-3"	"
6	" 6"x12"x22'-6"	"
4	" 6"x12"x13'-6"	"
8	3"x12"x22'-6"	SIS & IE
4	3"x12"x13'-6"	SIS & IE
14	3"x12"x19'-1"	M & D
4	3"x12"x26'-11"	M & D
14	3"x12"x13'-2"	M & D
10	[illegible]	Rough
48	[illegible]	HBI
40	[illegible]	PBI
128	[illegible]	
	[illegible]	
2200	Lin. Ft. 1"x4" Flooring	M & D
	20" c. c. Nails	

END ELEVATION



HALF ELEVATION

HALF SECTION

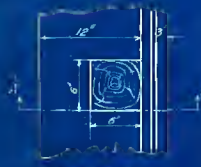
BILL OF MATERIAL IN GRILLAGE UNDER PIERS 1 & 2

No.	DESCRIPTION	REMARKS
88	[illegible]	SIS to 11'-3"
196	[illegible]	" " "
290	[illegible]	Bottom Course
1400	[illegible]	Upper Courses
48	Eye Bolts	EBI

SKETCH OF WROUGHT IRON PEDALS FOR NUT ON EYE BOLTS

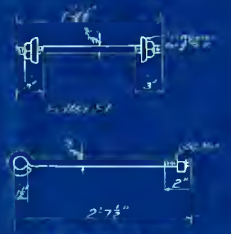
PLAN showing the various courses of Grillage.

SECTION A-A



SECTION C-C

DETAIL AT C. TT. M. & P. ST.



EYE BOLT ED. 1

HEAD OF BOLT 1

C.M. & P.S.Ry.

BRIDGE AND BUILDING DEPARTMENT.

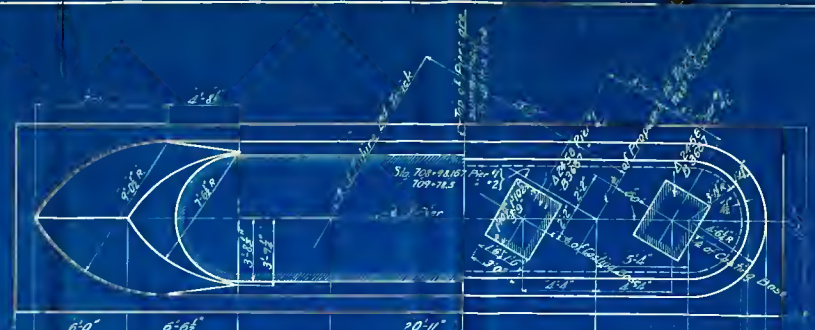
SPOKANE RIVER BRIDGE

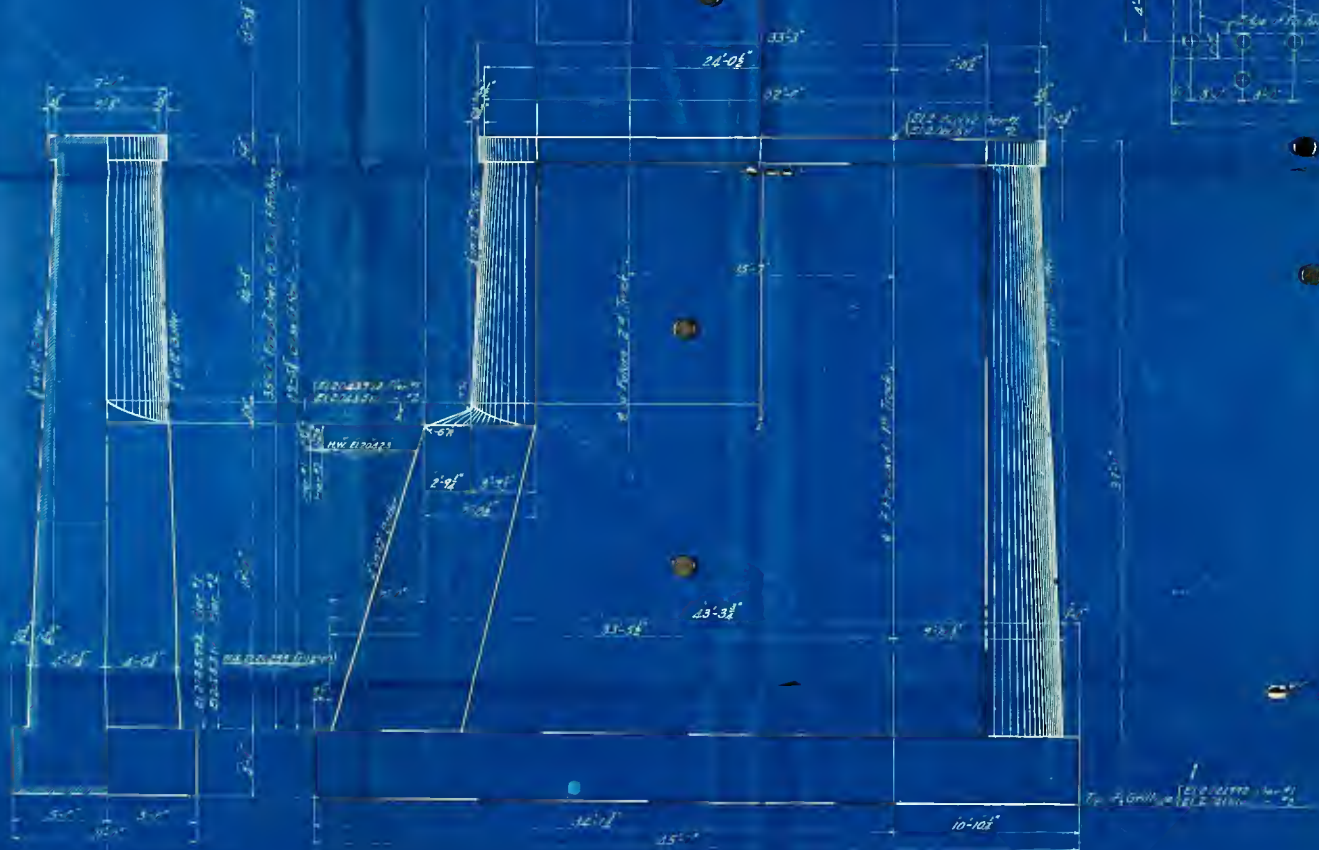
COEUR D'ALENE LINE COLUMBIA DIV. R

CAISSONS FOR PIERS Nos 1 & 2

CHICAGO, JUNE 2, 1904. DRAWING No. C-1370

CORRECT: H. Hunt ASST. ENGR. APPROVED: C. J. Lowell ENGR. CONST. P. S. R.





NOTES:

Cub. yds. of Concrete in Neatwork Piers Nos. 1&2 = 680
" " " " Footings " 1&2 = 430
Total Concrete = 1110

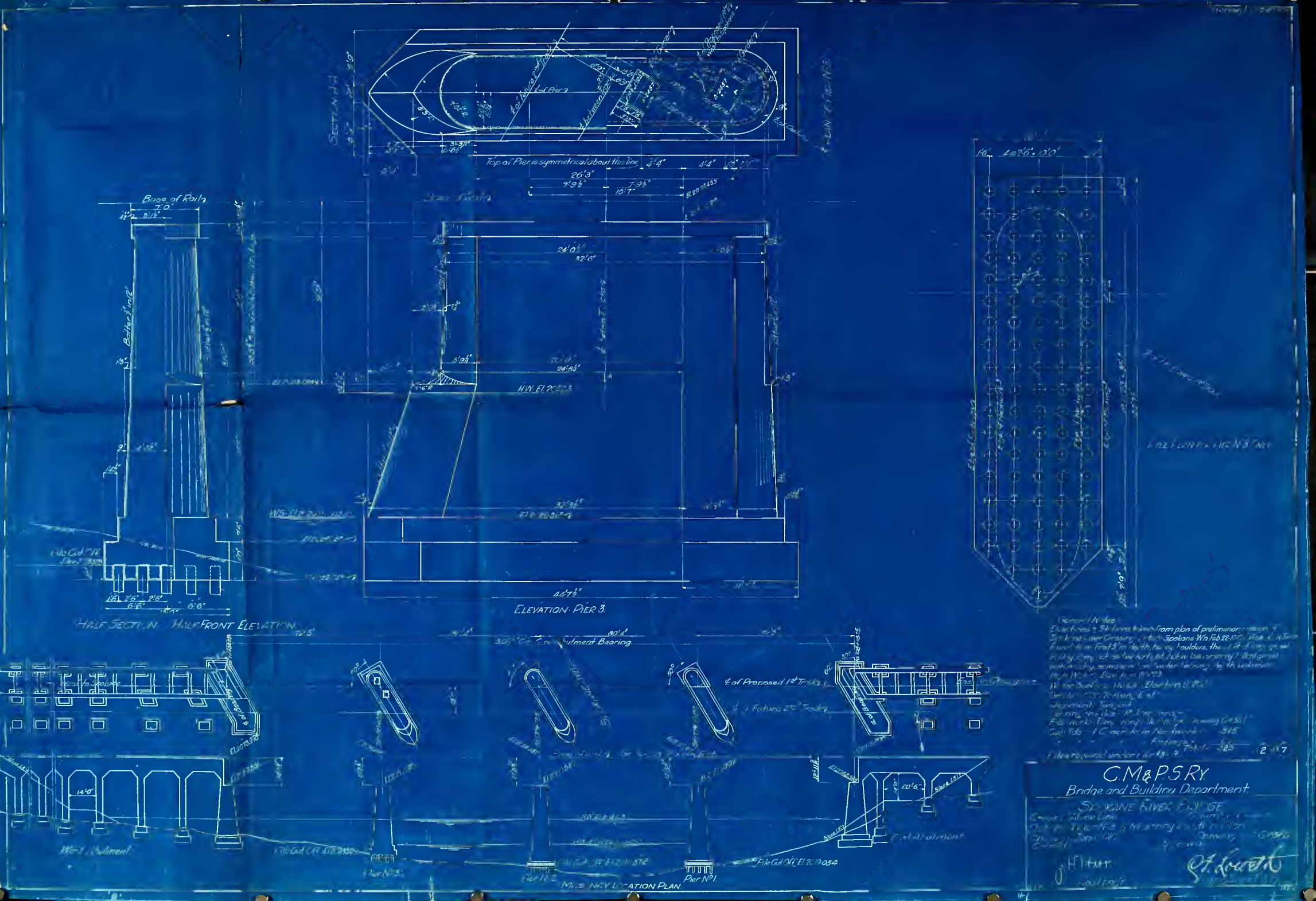
No. of Piles required under Piers Nos. 1&2 = 180
No. of Guide Piles required " " 1&2 = 8
Average Length of Piles in Piers Nos. 1&2 = about 47.5 ft.
For details of Drill or Core see Sheet No. 1 of this set of Plans
For Masonry Bearings and General Notes see Sheet No. C-1870

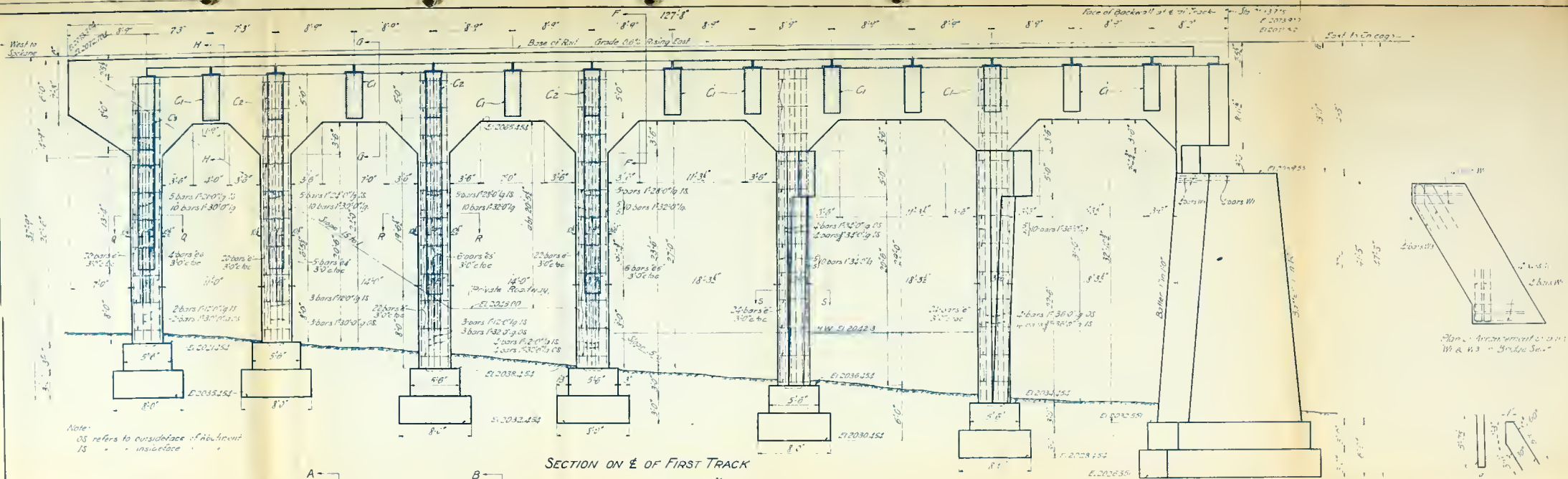
C.M.& P.S.Ry.
BRIDGE AND BUILDING DEPARTMENT.

SPOKANE RIVER BRIDGE
COEUR D'ALENE LINE — COLUMBIA DIVISION.
DETAILS OF PIERS NOS. 1&2

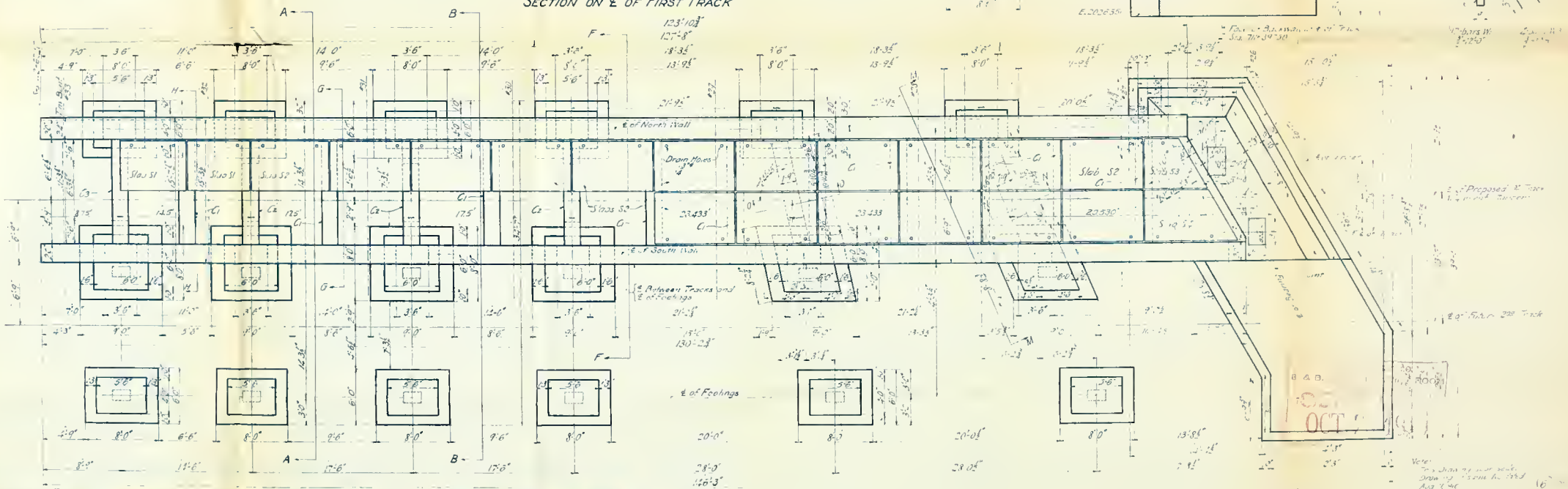
CHICAGO, JUNE 1910
CORRECT:
H.T. Hunt
ASST. ENGR.

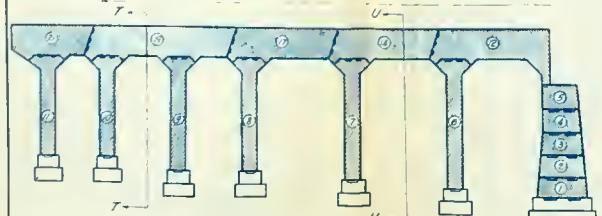
DRAWING NO. C-1868
APPROVED:
C.F. Loweth
ENGR. MAINT. WAY


Top of Pier is symmetrical about this line
ELEVATION PIER 3.
HALF SECTION
HALF FRONT ELEVATION
Base of Rails
H.W. El 2013.3
Pile Cut Off El 2013.312
Pile Cut Off El 2013.054
Pier No 3
Pier No 2
Pier No 1
M.S. N&Y LOCATION PLAN
C.M.&P.S.R.Y.
Bridge and Building Department
SPOKANE RIVER BRIDGE

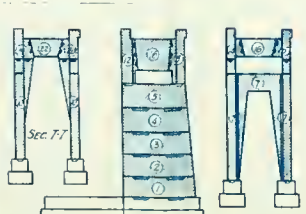


SECTION ON ℄ OF FIRST TRACK





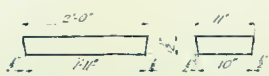
CONCRETING DIAGRAMS



SECTION U-U

PLAN

Notes as on Concreting Diagrams for East Abutment on Drwg. C6390 apply to West Abutment unless superseded by the following notes. For detail of key block K6 see sketch below. For details of key blocks K1, K4 and K5 see Drwg. C6390. Blocks K1 and K6 are shown thus ____ Sections which may be combined are (4) or (5) with (6), (7) with 22 etc.



SKETCH OF KEY BLOCK K6

General Notes: Foundation of material supposed to consist of hard clay. Bearing value taken at 3 tons per sq. ft. Maximum 5 tons per sq. ft. For additional general notes see Drwg. C6389. If Engineer in charge deems it necessary, roadway is to be protected against scour by riprap or paving. For construction data, see Drwg. C6389.

C. M. & P. S. Ry.

BRIDGE AND BUILDING DEPARTMENT.

SPOKANE RIVER BRIDGE

COEUR D'ALENE LINE — COLUMBIA DIVISION

WEST ABUTMENT — PLAN & ELEVATION

CHICAGO, AUG. 27, 1910

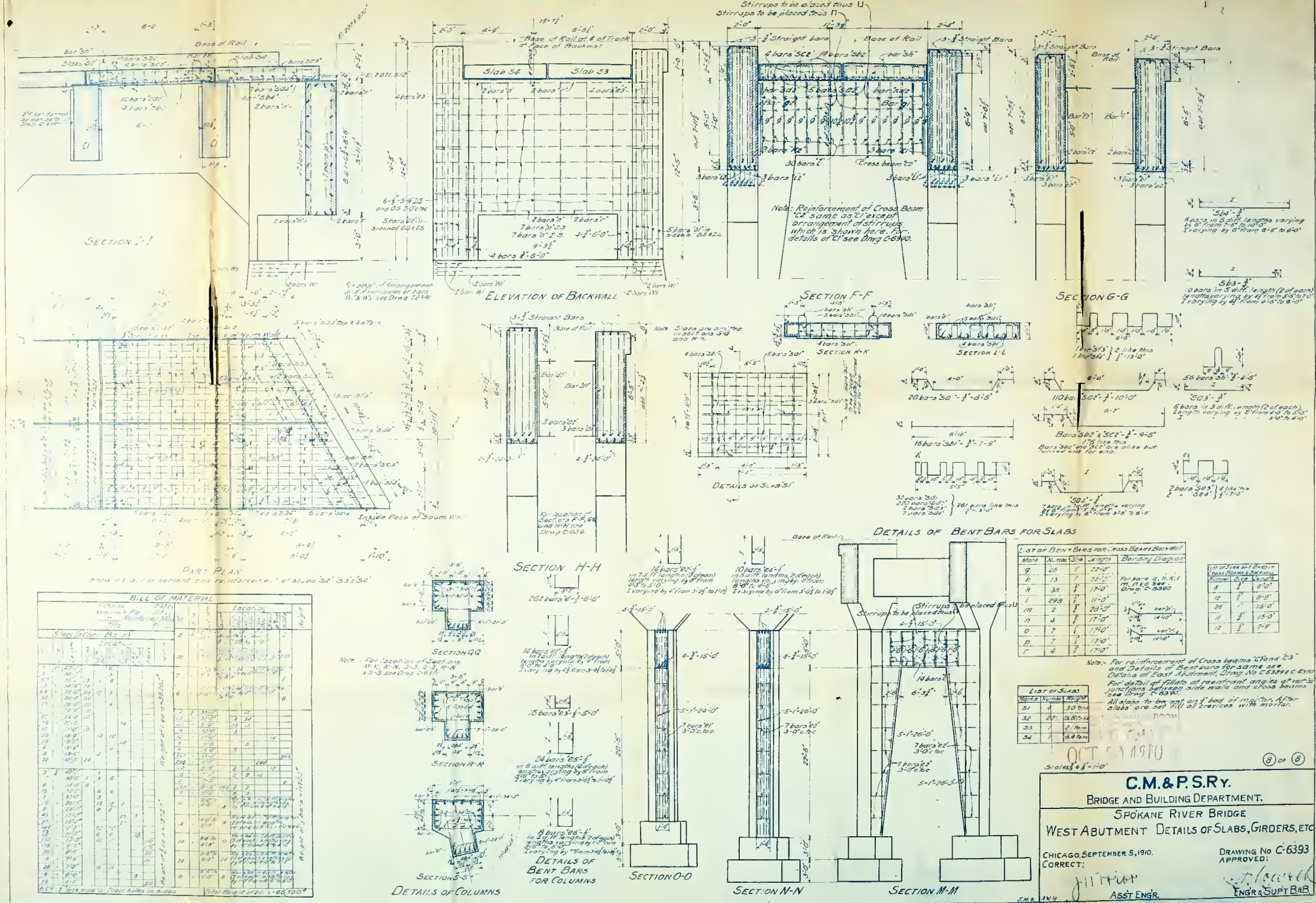
CORRECT

DRAWING NO. C6391

APPROVED

ASST. ENGR

ENGR. & SUPT. B. & B.



BILL OF MATERIAL

Steel (Conc. Bars)

Location

Total Weight of Conc. = 66,700#

654 - 8" diameter holes in slabs

LIST OF BENT BARS FOR CROSS BEAMS & BACK WALL

Mark	No. req'd	Size	Length	Bending Diagram
g	26	1"	22'-0"	For bars g, h, K, l, m, n, o, see Dwg. C-6390
h	13	1"	32'-0"	
K	33	1"	17'-0"	
l	299	1"	11'-0"	
m	2	1"	23'-0"	
n	4	1"	17'-0"	
o	7	1"	17'-0"	
p	7	1"	17'-0"	
r	4	1"	17'-0"	

LIST OF SLABS

Marks	Number	Weight
S1	4	30 Tons
S2	22	36 Tons
S3	1	21 Tons
S4	1	34 Tons

LIST OF STRAIGHT BARS IN CROSS BEAMS & BACK WALL

Number	Size	Length
8	1"	6'-0"
12	1"	8'-9"
26	1"	15'-0"
11	1"	15'-0"
12	1"	7'-9"

(8) OF (8)

C.M.&P.S.Ry.

BRIDGE AND BUILDING DEPARTMENT.

SPOKANE RIVER BRIDGE

WEST ABUTMENT DETAILS OF SLABS, GIRDERS, ETC

CHICAGO, SEPTEMBER 5, 1910.

DRAWING No C-6393

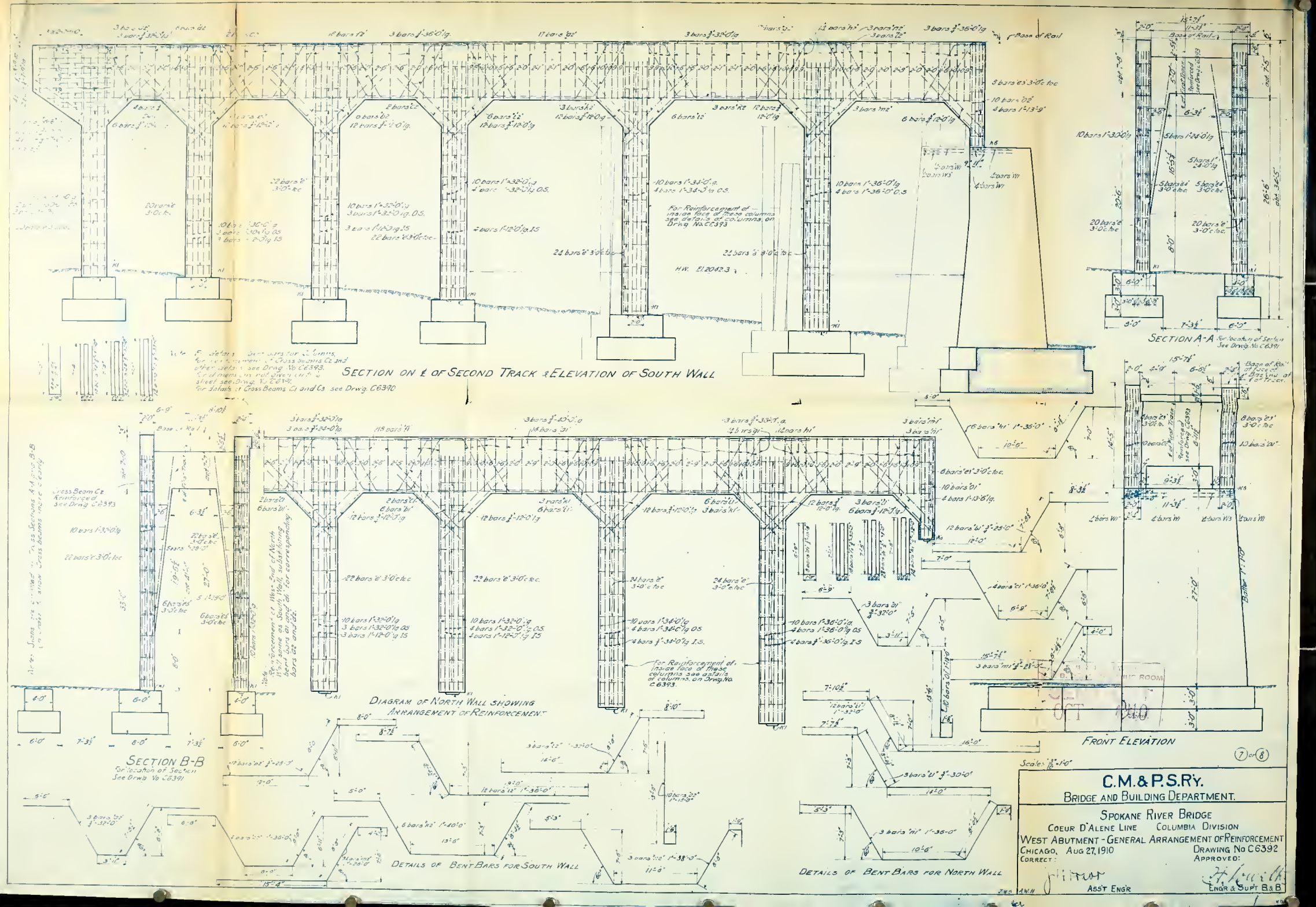
APPROVED:

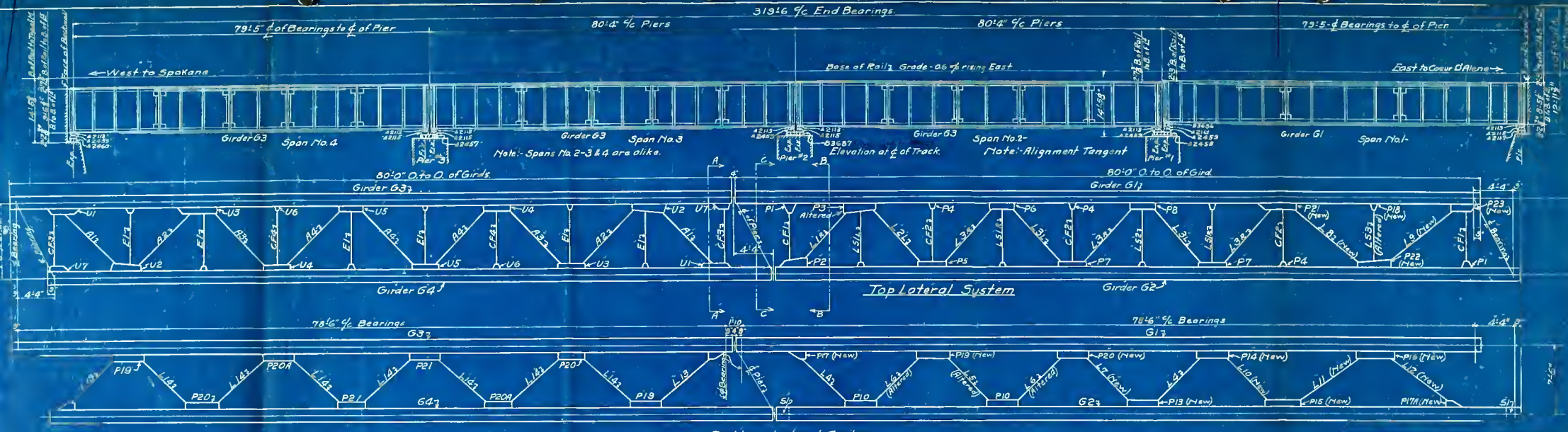
CORRECT:

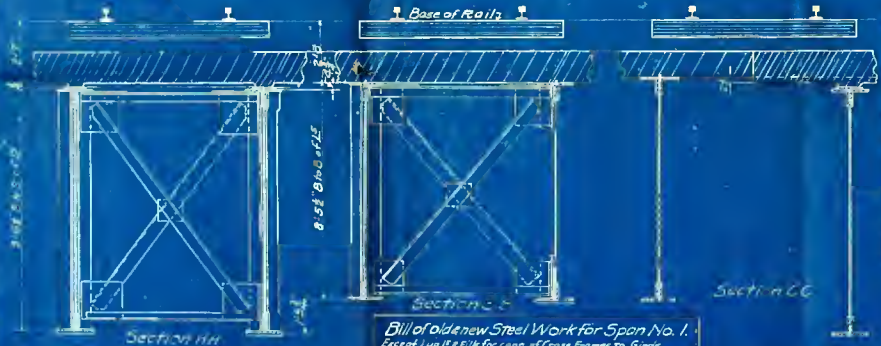
ASST ENGR.

ENGR & SUPT B&B

OCT 3 1910


SECTION ON ℄ OF SECOND TRACK & ELEVATION OF SOUTH WALL
SECTION A-A
SECTION B-B
DIAGRAM OF NORTH WALL SHOWING ARRANGEMENT OF REINFORCEMENT
FRONT ELEVATION
DETAILS OF BENT BARS FOR SOUTH WALL
DETAILS OF BENT BARS FOR NORTH WALL
Base of Rail
H.W. El. 2042.3
For Reinforcement of inside face of these columns see details of columns on Drwg. No. C6393.
Scale 3/8" = 1'-0"
7 of 8
C.M.& P.S.Ry.
BRIDGE AND BUILDING DEPARTMENT.
SPOKANE RIVER BRIDGE
COEUR D'ALENE LINE COLUMBIA DIVISION
WEST ABUTMENT - GENERAL ARRANGEMENT OF REINFORCEMENT
CHICAGO, AUG 27, 1910
DRAWING No C6392
CORRECT:
APPROVED:
ASST ENGR
ENGR & SUPT B & B





Bill of Steel Work for Spans No. 2-3-4.
Furnished by Contractor.

No.	Description	Mark	Dr. No.
2	Girders	G3	C6377 C6378
3	"	G4	C6377 C6378
6	End Cross Frames	CF3	C6378
5	Inter "	CF4	"
6	Transverse Struts	E1	C6377 C6379
6	Top Laterals	A1	C6377 C6378
6	"	A2	C6377 C6378
6	"	A3	C6377 C6378
6	"	A4	C6377
6	Top Lateral Rds	U1	C6377 C6379
6	"	U2	C6378 C6379 C6380
2	"	U3	C6378
2	"	U4	C6377
2	"	U5	"
2	"	U6	"
3	"	U7	C6379 C6380
3	Bottom Laterals	L13	C6379 C6380
3	"	L14	C6379 C6380
3	Strut Laterals	L15	C6379
3	"	L16	C6379
5	"	L17	C6379
5	"	L18	C6379
5	"	L19	C6379

Bill of Castings, Bolts & Sheet Lead
Furnished by Ry. Company.

No.	Description	Mark	Location	Dr. No.
16	Top Rockers	2113	Expansion & Fixed Ends.	A9200
8	" (Filler)	2115	Fixed Ends	"
8	"	2380	Expansion Ends	"
8	Bolts, Steel	2434	Between 2459 & 3742	
2	Castings	2115	Betw. G1 & G2 & 2115	C6381
2	Shoe Rockers	2115	" 2115 & East Abutment	A9200
2	"	2459	" 2459 & West "	"
2	"	2115	" 2115 & Pier No. 2	C6381
2	"	2459	" 2459 & " " 3	A9200
2	"	2115	" 2115 " " 3	"
10	Shoe Plates		Connecting Top & Bot. Rockers	A9200
8	"		28 x ⅞ x 3'-0"	
8	"		36 x ⅞ " 3'-9	
1.0	Bolts, 1¼ dia. x 4½ thick nuts		Girds & Rockers & Rockers & Bed Pls.	
12	Washers 8½-12"x 1¼"			5800

List of Drawings.
For Spokane River Bridge.

Dr. No.	Sheet No.	Description
C6360		Details of Piers-No 1-&2
C6369		" " Pier " 3
C6370		" " Caissons
C6376	1 of 6	Bill of Matl & Marking Diagram
C6377	2 of 6	Details of 80-0 Deck Girder Span.
C6378	3 of 6	" " " " "
C6379	4 of 6	" Changes on 80-0 Deck Gird Span
C6380	5 of 6	" " " " "
C6381	6 of 6	" Castings
C6389		" East Abutment
C6390		" " "
C6391		" West "
C6392		" " "
C6393		" " "

Bill of Field Rivets for Spans No. 2-3-& 4.
Furnished by Contractor

No. Reqd.	Diam	Grip	Length	Kind	Location
42	⅞	1⅛	3¼		Top Lat Rds. to Lats. to Girds
162	"	2⅜	4	"	" " " " " "
306	"	1⅛	3¼	"	Top Lat Rds to Girds
78	"	1⅛	2⅝	"	" " " "
228	"	⅝	2⅛	"	Top Lat Rds to Laterals
6	"	1⅛	3¼	"	Struts to Lat Rds. to Girds.
30	"	2⅜	4"	"	" " " "
36	"	⅞	2⅜	"	" to Top Lat Rds.
24	"	2⅜	4	"	Cross Frames to Top Lat Rds to Girds
12	"	⅝	3½	"	" " " " "
72	"	⅝	2⅜	"	Cross Frames to Top Lat Rds.
6	"	1⅛	3¼	"	Bott Lat Rds to Lats to Girds.
24	"	2⅜	4	"	" " " " "
66	"	1⅛	3½	"	" to Girds
90	"	2⅜	4¼	"	Bott Lats to Lat Rds
162	"	⅝	2⅜	"	End Cross Frames to Stiffs
12	"	2⅜	4	"	
72	"	1⅛	3½	"	
12	"	1⅛	2⅜	"	
72	"	1⅛	2⅜	"	
12	"	1⅛	2⅞	"	Inter Cross Frames to Stiffs
36	"	½	2⅜	"	
24	"	3⅛	4⅜	"	Bott Lat Rds to Lats to Girds

Summary of Field Rivets
Reqd. for Spans No. 2-3-&4. + abt 10 o/o
Furnished by Contractor.

No. Reqd.	Diam	Length	Kind
745	⅞	2⅜	
90	"	2¾	"
30	"	2⅞	"
80	"	3½	"
500	"	3¾	"
200	"	4"	"
110	"	4½	"
30	"	4⅝	"

Bill of Old & new Steel Work for Span No. 1.
Except Lug & Fills for conn. of Cross Frames to Girds.

No.	Description	Mark Old	Mark New	Drawing No. Old	Drawing No. New
1	Girder (Filler)	G1	G1	C1180	C6376 C6380
1	" (Filler)	G2	G2	C1180	"
2	End Cross Frames	CF1	CF1	"	C6380
3	Inter "	CF2	CF2	"	"
2	Lateral Struts	L5	L5	"	C6379
1	" (Filler)	L5	L5	"	C6378 C6380
1	Top Laterals	L2	L2	"	"
3	"	L3	L3	"	C6378 C6380
2	" (Web)	L3	L3	"	C6380 C6379 C6380
1	" (Web)		L8		C6380
1	" (Web)		L9		C6380
2	Bottom Laterals	L4	L4	C1180	C6382
1	" (Filler)	L4	L5	"	C6379
2	" (Filler)	L4	L6	"	C6379 C6378
1	" (Web)		L7		
1	" (Web)		L10		C6380
1	" (Web)		L11		"
1	" (Web)		L12		"
2	Top Lateral Rds	P1	P1	C1180	C6379 C6380
1	" (Filler)	P2	P2	"	"
3	"	P3	P3	"	C6379 C6380
1	"	P4	P4	"	C6380 C6379
1	"	P5	P5	"	"
1	"	P6	P6	"	C6379 C6378 C6380
2	"	P7	P7	"	"
1	"	P8	P8	"	C6380
1	" (Web)		P21		C6380
1	" (Web)		P22		"
1	" (Web)		P23		"
1	"		P18		"
2	Cast Shoe	P10	P10	C1180	C6379 C6380
			P17		C6380

Bill of Old & new Steel Work for Span No. 1
Except Lug & Fills for conn. of Cross Frames to Girds
(CONTINUED)

No.	Description	Mark Old	Mark New	Drawing No. Old	Drawing No. New
1	Top Lateral Rds (Web)		P17		C6379 C6380
1	" " " (")		P17A		C6380
1	" " " (")		P18		C6379
1	" " " (")		P20		C6380
1	" " " (")		P21		C6379
1	" " " (")		P22		"
1	Top Lateral Struts	L22	L52	C1180	C6380 C6379
2	Fills for Shoe Plates (Web)		51		C6380

Bill of Old & new Steel Work for Span No. 1
Furnished by Contractor
(CONTINUED)

No.	Description	Mark	Dr. No.
1	Top Lateral Rds	L8	C6380
1	"	L9	"
1	End Horn	L7	C6379
1	"	L10	C6380
1	"	L11	"
1	"	L12	"
1	Top Lateral Rds	P21	"
1	"	P22	"
1	"	P23	"
1	"	P18	"
1	Bottom "	P13	"
1	"	P14	"
1	"	P15	"
1	"	P16	"
1	"	P17	C6379
1	"	P17A	C6380
1	"	P13	C6379
1	"	P20	"
2	Lug & Fills for Cross Frames	a1	C6378 C6380
2	" " " "	a1	"
1	" " " "	a2	C6379
1	" " " "	a3	"
1	" " " "	a4	"
1	" " " "	a5	"
1	" " " "	a6	C6382

Bill of Old & new Steel Work for Span No. 1
Furnished by Contractor
(CONTINUED)

No.	Description	Mark	Dr. No.
1	Lug & Fills for Cross Frames	a7	C6380
1	" " " "	a8	"
1	" " " "	a9	"
4	Fillers for Lug &	f1	C6378 C6380
1	" " " "	f2	C6378
1	" " " "	f3	"
1	" " " "	f4	"
1	" " " "	f5	"
1	" " " "	f6	C6380
1	" " " "	f7	"
1	" " " "	f8	"
1	" " " "	f9	"
8	For Splice Ls	51	C6380

Bill of Field Rivets for Span No. 1
Furnished by Contractor.
This Bill is in addition to Rivets now in Field.

No. Reqd.	Diam	Grip	Length	Kind	Location
8	⅞	2⅜	4		Top Lat Rds to Girds
12	"	1⅛	3¼	"	" " " "
8	"	2⅜	4	"	Cross Frames to Top Lat Rds to Girds
24	"	1⅛	3¼	"	" " " " " " "
6	"	1⅛	3¼	"	Struts to Lats to Girds
6	"	1⅛	2⅜	"	Lats to Girds
24	"	1⅛	2⅜	"	Inter Cross Frames to Girds

Summary of Field Rivets
Reqd. for Span No. 1 + abt 10 o/o
Furnished by Contractor
Rivets for plugging and incl.

No. Reqd.	Diam	Length	Kind
8	⅞	4	
24	"	3¼	"
6	"	3¼	"
24	"	2⅜	"

Bill of Field Steel Work, not required for Shoes
To be put into S

No.	Description	Mark	Dr. No.
1	Inter End Cross Frames	CF2	C1180
1	Top Lat Rds	L1	"
1	"	L2R	"
1	"	L3L	"
6	"	L4	"
1	Top Lateral Rds	P2	"
1	"	P3	"
1	"	P4	"
1	"	P5	"
1	"	P6	"
1	Bolts	P3	"
2	"	P10	"
4	"	P11	"
1	"	P12	"

Summary of Field Rivets abt 10% for plugging holes in Flanges of Girds - G1 & G2, Span No. 1

No. Reqd.	Diam	Length	Kind
[illegible]			

C.M. & P.S. Ry.
BRIDGE AND BUILDING DEPARTMENT.
SPOKANE RIVER BRIDGE
SPOKANE & COEUR D'ALENE LINE COLUMBIA DIVISION
BILL OF MATERIAL AND ERECTION DIAGRAM
Drawing No. 376
Approved:
Engr. & Supt. B&B.